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HANDBOOKS OF AMERICAN NATURAL HISTORY

edited by

Albert Hazen Wright

Volume I

HANDBOOK OF FROGS AND TOADS

by

Anna Allen Wright
Albert Hazen Wright

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HANDBOOK OF FROGS AND TOADS

The Frogs and Toads of the
United States and Canada

By

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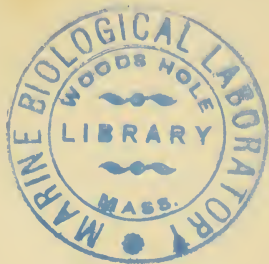
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This little volume, meant to serve the public, the scientist, and the group treated, is dedicated to the four American women who, in addition to serving the public and science generously, have in the last half-century contributed most notably to the study of this group:

MARY HEWES HINCKLEY, 1845-
MARY CYNTHIA DICKERSON, 1866-1923
HELEN DEAN KING, 1869-
HELEN THOMPSON GAIGE, 1889-

Preface

In 1930, while preparing a monograph and also an illustrated key of North American frogs, we resolved on a small book as a guide for teachers, students, and even younger naturalists. Of each species, there is a plate of photographs from life and a two-page résumé of its characters and habits. The plates and script are meant to cultivate an interest in the lay mind and help the beginner in his or her quests. Several species which since 1930 have appeared in the United States or Canada, we have been unable to illustrate, e.g., *Bufo americanus copei*. We have, however, attempted to illustrate all subspecies whether they be on slender or firm grounds. Pictures from life of many of these debatable forms have never been presented before. Even though it may eventually prove there is one meadow frog, yet the four forms are presented; even though only one or two forms of *Pseudacris nigrita* may be good, yet all five subspecies appear herein. The pictures from life may help to stimulate an elucidation of some of these moot questions in our knowledge.

The photographs are largely new and not from our previous publications, and are the work of the authors. In the species accounts there occasionally appears a croaker, a tadpole or an egg photograph formerly used in the Frogs of the Okefinokee Swamp. Such pictures were taken by F. Harper and the authors. Many of the frogs were photographed in a jar of water and the water line is evident on the fore part of the body or on either side of the head.

While this work was going through the press, the third edition (1933) of Check List of North American Amphibians and Reptiles by L. Stejneger and T. Barbour appeared. The Check List indicates that the range of *Hyla gracilipes* extends from southern Arizona southward. We overlooked this statement in Dr. Kellogg's (1932) paper and this species does not appear in this work.

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General Account

In the treatment of each species, the topical outline is as follows:

Common names	General appearance
Scientific name	Structure
Range	Voice
Habitat	Breeding
Size	Notes

Common names. We of the United States and Canada have concerned ourselves little with distinctive names for the amphibians. Most of the common names of the salamanders and frogs are collective. Just as all salamanders are generally called water dogs or lizards, so also the frogs are known by few common names, (toads, frogs or tree frogs). For example, people use the word "peeper" indiscriminately for several small frogs that call in the early spring. Others call peepers lizards.

Normally we expect common names to come from the people at large, but with amphibians and reptiles, most of the common names in literature are really bookish names. Many are translations of the scientific names. The names may come from widely different sources of which the following are a few:

(1) The person after whom the species is named. Example: Couch's spadefoot. *Scaphiopus couchii* Baird.

(2) The person who named the species. Example: Viosca's tree frog. *Hyla avivoca* Viosca.

(3) The person who first collected it. Example: Taylor's toad. *Hypopachus cuneus* Cope.

(4) A country. Examples: Canadian toad, American bell toad, Mexican toad.

(5) A state or province. Examples: Sonora hyla, Winnipeg toad, California red-legged frog.

(6) Habitats. Examples: River-swamp frog, pond frog, house frog, salt marsh frog, canyon tree toad, desert tree toad, crayfish frog, gopher frog, wood frog, savanna cricket, cliff frog.

(7) Habits. Examples: Chameleon tree frog, solitary spadefoot, grasshopper frog.

(8) Structural characters. Examples: Ribbed toad, narrow-mouthed toad, toothless frog, femoral hyla, thick skinned frog.

(9) Voice. Examples: Bell frog, screaming frog, pig frog, rattler, chorus frog, cricket frog.

(10) Color. Examples: Three lined tree frog, striped tree frogs, ornate tree frog, green toad, cinereous hyla.

(11) Seasons. Examples: Spring peeper, shad frog.

(12) Miscellaneous sources of many kinds: Folklore. Example: Charming toad. Legend says this toad, *B. terrestris*, turns your eye green. Use (bait). Example: Pickerel frog. Weather signs. Example: Rain frog. Odor. Example: Mink frog.

Scientific name. Any consideration of the scientific name which an animal bears implies an understanding of the scheme of classification. All living things fall into two groups or kingdoms. The plants are treated in the science of Botany, the animals in Zoology. The animal kingdom has several major subdivisions or phyla, the last being the *Vertebrata* (vertebrates). In the vertebrate phylum, the various classes are known as fishes (*Pisces*), amphibians (*Amphibia*), reptiles (*Reptilia*), birds (*Aves*) and mammals (*Mammalia*). We designate the study of fishes as Ichthyology, that of birds, Ornithology, that of mammals, Mammalogy, but we group together amphibians and reptiles as the science of Herpetology. This merging of the two groups is in a measure due to our inability to designate infallible characters of separation. A fish has fins, a bird, feathers, a mammal, hair, but reptiles and amphibians have no one positively distinctive character.

The amphibians to which the order of frogs (*Salientia* or *Ecaudata*) belongs have been variously defined. Some fifteen to twenty characters have been employed. Among them are the following: Most living amphibians have naked skin and a larval aquatic stage. Normally as tadpoles or larvae, they breathe with gills air dissolved in the water, and as adults they breathe with lungs. Two of the membranes about a developing mammal are absent in amphibians. There are three living orders:

Apoda (caecilians) are limbless, blind, and wormlike. None occur in United States or Canada.

Caudata (salamanders) are as adults tailed.

Salientia (frogs) are as adults tailless.

Seven families of *Salientia* or ecaudate amphibians are represented by 86 species or subspecies in the United States and Canada. Family names in zoology and botany end in *idae*. These seven families with the number of species and subspecies in the United States and Canada are:

- | | |
|--|----------------------------|
| 1. Bell toads, <i>Discoglossidae</i> . | 1 species. |
| 2. Spadefoots, <i>Scaphiopodidae</i> . | 5 species and subspecies. |
| 3. Toads, <i>Bufonidae</i> . | 18 species and subspecies. |
| 4. Treetoads, <i>Hylidae</i> . | 28 species and subspecies. |
| 5. Robber frogs, <i>Leptodactylidae</i> . | 6 species. |
| 6. Frogs, <i>Ranidae</i> . | 24 species and subspecies. |
| 7. Narrow-mouthed toads, <i>Brevicipitidae</i> . | 4 species. |

Some of these families are divided into subfamilies. The ending for subfamily names is *inae*. Thus, the true frogs considered in this work belong to the family *Ranidae* and the subfamily *Raninae*.

The family is divided into genera and the genera into species.

Ordinarily a scientific name consists of three parts; the first name being the generic name, the second the specific name and the third the author or describer who first gave the name. The specific Latin name serves as an adjective agreeing in gender and number with the generic name which is treated as a noun. This is the binomial system of nomenclature. The meadow frog might serve as an example. It is called *Rana pipiens* Schreber. The generic name is written with a capital and the specific name with a small letter. If the species be divided into one or more subspecies or races, the name may consist of four parts: namely—genus, species, subspecies and authority. Such a name is an example of trinomial nomenclature. The swamp cricket frogs *Pseudacris nigrita* (Le Conte) may be divided into several subspecies written thus, *Pseudacris nigrita nigrita* (Le Conte); *P. n. septentrionalis* (Boulenger), etc. Witness the abbreviations after the names *Pseudacris* and *nigrita* are once spelt out.

Kingdom	Animal	Subfamily . . .	Raninae
Phylum	Vertebrata	Genus	Rana
Class	Amphibia	Species	pipiens
Order	Salientia	Subspecies . .	burnsi
Family	Ranidae	Authority . . .	(Weed)

Name: *Rana pipiens burnsi* (Weed)

Range. The core of this information will be found in "A Check List of North American Amphibians and Reptiles" by Leonhard Stejneger and Thomas Barbour, Harvard University Press, 1923.

We have added our own records through the years plus such records as we have found in some of the smaller collections.

Habitat. This topic usually refers to non-breeding habitats, but at times allusions are made to breeding localities as well.

Size. The formula we have employed is: Adults $3\frac{1}{5}$ – $6\frac{3}{5}$ inches (Males, 80–156 mm. Females, 87–165 mm.). These are the measurements of the large Colorado River toad, *Bufo alvarius* Girard. They mean that breeding adults range from $3\frac{1}{5}$ to $6\frac{3}{5}$ inches in length of body from tip of snout to rear end of the body back of the vent. The $3\frac{1}{5}$ inches or 80 mm. is the smallest size at which males mature and $6\frac{3}{5}$ inches or 165 mm. is the largest size of any measured female. Almost invariably the lower measurement in inches will be that of a male and the greater adult measurement, the size of a female.

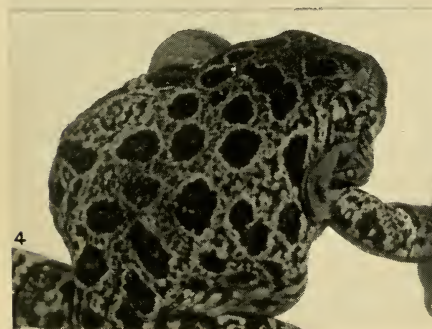
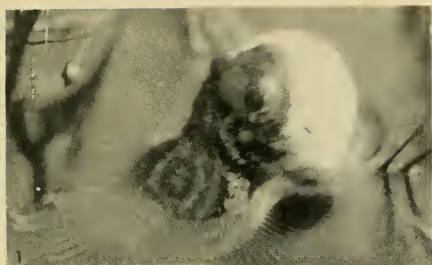
Jordan and Evermann considered the two killifishes, *Heterandria formosa* and *Lucania ommata*, the smallest vertebrates of North America. We have collected many of these tiny fish, but confidently

pronounce the little chorus frog, *Pseudacris ocularis*, much smaller. Cuba we understand has a still smaller frog.

Most of the seven families have extremes in size. The tree frog adults vary from 7/16 inch (11.5 mm.) in the little chorus frog (*Pseudacris ocularis*) to 5 1/5 inches (130 mm.) in the Key West tree frog (*Hyla septentrionalis*). The robber frog adults vary from 5/8 inch (15 mm.) in Camp's frog (*Syrrhophus campi*) to 3 1/2 inches (90 mm.) in the Texas cliff frog (*Eleutherodactylus latrans*). The adult toads vary from 3/4 inch (19 mm.) in the oak toad (*Bufo quercicus*) to 6 3/5 inches (165 mm.) in the Colorado River toad (*Bufo alvarius*). The adult spadefoots vary from 1 1/2 inches (37.5 mm.) in Hammond's spadefoot (*Scaphiopus hammondii*) to 2 3/4 inches (72 mm.) in Holbrook's spadefoot (*Scaphiopus holbrookii holbrookii*). The adult frogs vary from 1 3/8 inches (36 mm.) in the northern wood frog (*Rana cantabrigensis*) to 8 inches (200 mm.) in the bullfrog (*Rana catesbeiana*). Two groups have little variation in their extremes. The narrow-mouthed toads vary in adults from 4/5 inch (20 mm.) in the Texas narrow-mouthed toad (*Gastrophryne texensis*) to 1 5/8 inches (41 mm.) in Taylor's toad (*Hypopachus cuneus*). The one species of ribbed toads (*Ascaphus truei*) varies from 1 1/8–2 inches (28–51 mm.) in length.

General appearance. Usually, these accounts were written with a live specimen or specimens in hand. Each gives the form of body (habitus) of the animal, the color of the animal and some of the other outstanding characters. Often the animal is compared to a closely related species or to the common type of the group. In a debatable form, excerpts from the original description or from subsequent pertinent accounts are given to help in solving the difficulties surrounding the species.

Structure. This section is meant to supplement the characters given under *general appearance* or to add to characters used in the keys. Wherein *general appearance* is written from living animals, *structure* is added from examinations of preserved specimens and from published descriptions. Unless otherwise stated, all measurements in descriptions or keys are relative to the body-length (represented by L.). This paragraph is written in the abbreviated form preferred in scientific descriptions.



- PLATE I. Croaking Males.
 1. Common spadefoot ($\times \frac{1}{2}$).
 2. Cricket frog ($\times 1$). 3.
 Southern bullfrog ($\times \frac{1}{8}$). 4.
 Northern gopher frog ($\times \frac{1}{2}$).

Voice. Early travellers often commented on the frog music of our country. Witness the following:

"There be also store of frogs, which in the spring time will chirp, and whistle like birds; there be also toads, that will creep to the top of trees, and sit there croaking, to the wonderment of strangers!"

"To the stranger walking for the first time in these woods during the summer, this appears the land of enchantment: he hears a thousand noises, without being able to discern from whence or from what animal they proceed, but which are, in fact, the discordant notes of five different species of frogs!"

"Previous to my coming to this country, I recollect reading the foregoing passages, the first in a history of New England, published in London, in the year 1671; and the other in a similar production of a later date.

"Prepared as I was to hear something extraordinary from these animals, I confess the first frog *concert* I heard in America was so much beyond anything I could conceive of the *powers* of these *musicians*,

that I was truly astonished. This performance was *al fresco*, and took place on the night of the 18th instant (Apr. 18, 1794, Philadelphia), in

a large *swamp*, where there were at least ten thousand *performers*; and I really believe not two *exactly* in the same pitch, if the octave can possibly admit of so many divisions or shades of semitones. An hibernian musician, who, like myself, was present for the first time at this *concert of antimusic*, exclaimed, 'Begorrah, but they stop out of tune to a *nicety*.'

"I have been since informed by an *amateur*, who resided many years in this country, and made this species of *music* his peculiar study that on these occasions the *treble* is performed by the tree-frogs, the smallest and most *beautiful* species; . . . their note is not unlike the chirp of a cricket: the next in size are our *counter tenors*; they have a note resembling the *setting* of a *saw*. A still larger species sing *tenor*; and the *under part* is supported by the bull-frogs; which are as large as a man's foot, and *bellow* out the *bass* in a tone as loud and sonorous as that of the animal from which they take their name."

(Wm. Priest's Travels. London, 1802, pp. 48-50).

In general, all male frogs have voices. Though some books state that females are not croakers, nevertheless some can talk, croak or scream. Any frog if seized or maddened may squeal or give a mercy cry. This is done with open mouth. To croak a frog keeps his mouth closed. In this way he can croak under water. Croaking consists in pushing the air out of the lungs into the mouth and from there into the sac or sacs by an opening on either side of the tongue or at the angle of the mouth. Then the sacs deflate and the lungs refill.

The calls of frogs have been likened to the noises of domestic animals like the cat, dog, pea-fowl, lost chickens, young or hen turkeys, ducks, bulls, pigs, lambs, goats; or have been compared to the calling or snoring of humans. To some they call like various birds, or like alligators, bats, etc. All kinds of mechanical or musical figures have been employed to portray their calls. Each species has its distinctive breeding call but it may have several other calls in addition. Usually the males begin calling before the females arrive at the ponds.

Only the males have vocal sacs and these are diverse. The ribbed frogs of our west coast have no vocal sacs. The narrow-mouthed toads, spadefoots, cricket frogs, chorus frogs and tree frogs, have a single median chin sac, round in outline when distended. The males of these and the toads, with the exception of spadefoots, have dark throats. Some tree frogs may have the side of the chin and throat more inflated than its center. The toads have single throat sacs. In several species the sac comes out from the lower throat like a sausage case. Many of the true frogs have single throat sacs. Some have the chin swollen out but not saclike. Others have a sac on either side of the head between ear and shoulder as in our common leopard frog. In one or two they appear like round marbles when distended. In some frogs, like the gopher frogs, the whole side of the body swells out when they croak.

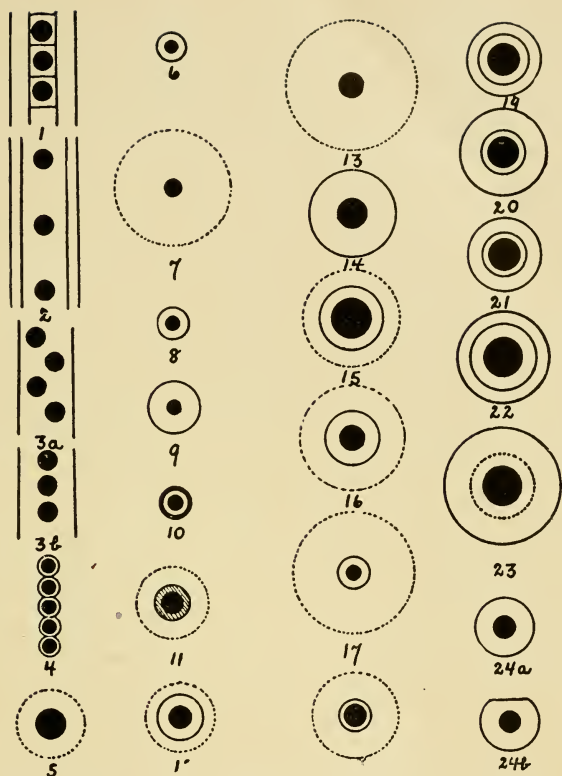


PLATE II. Individual Eggs. ($\times 2.3$.)

- | | |
|------------------------------------|--------------------------------------|
| 1. <i>Bufo a. americanus</i> | 13. <i>Rana catesbeiana</i> |
| 2. <i>Bufo terrestris</i> | 14. <i>Rana virgatipes</i> |
| 3. <i>Bufo fowleri</i> | 15. <i>Rana grylio</i> |
| 4. <i>Bufo quercicus</i> | 16. <i>Rana clamitans</i> |
| 5. <i>Scaphiopus h. holbrookii</i> | 17. <i>Hyla femoralis</i> |
| 6. <i>Pseudacris ocularis</i> | 18. <i>Hyla v. versicolor</i> |
| 7. <i>Pseudacris n. triseriata</i> | 19. <i>Rana palustris</i> |
| 8. <i>Hyla crucifer</i> | 20. <i>Rana p. pipiens</i> |
| 9. <i>Acris gryllus</i> | 21. <i>Rana sphenoccephala</i> |
| 10. <i>Hyla squirella</i> | 22. <i>Rana aesopus</i> |
| 11. <i>Hyla gratiosa</i> | 23. <i>Rana sylvatica</i> |
| 12. <i>Hyla c. cinerea</i> | 24. <i>Gastrophryne carolinensis</i> |

In No. 15, the vitellus was inadvertently drawn too large.

Eggs. The eggs of about 15 species have not been found and the eggs of 15 species have been found but not described. In all some 30 species need more attention paid to them.

Relatively, the eggs of some of the smaller frogs like the robber frogs or little chorus frogs are largest while the bullfrog may have some of the smallest eggs. The size of the adult then does not determine the size of the egg. The ribbed toad and robber frogs have unpigmented eggs. The latter go through their whole development in the egg which is laid on land. All the rest of the frogs have pigmented eggs.

In the North the egg laying season may be very short while in the South some species may breed almost any month of the year. The number of eggs a female may have to lay varies from 6 in the robber frogs, or 100 in the little chorus frog, to 20,000 in the bullfrog. Some lay single eggs on the bottom of the pond or stream. They may be attached to vegetation or free, submerged in the water or floating. Many lay floating films. Most forms in northern countries lay submerged eggs. Some like toads have the eggs in strings or tubes of jelly though one toad has them in bars of 4 or 5 eggs and another lays single eggs. Others, like spadefoots, may have them in bands, later cylinders, or even have the eggs on stalks of jelly. One, the ribbed toad, has the eggs in a rosary string. Some, like wood frogs and meadow frogs, have globular or plinthlike masses.

The egg proper, or yolk, is called the vitellus, which usually has a rather tight fitting membrane called the vitelline membrane. The vitellus usually has the upper half or animal pole pigmented black, brown, etc., while the lower half or vegetable pole is unpigmented, white, cream, or yellowish. These pigmented eggs are normal to most frogs which lay their eggs in water exposed to the sunlight, but a few frogs in the United States lay their eggs on land and away from the sunlight. Such are unpigmented. About the egg there may be one or two or more jelly envelopes which become evident a few minutes after the egg is laid. In some masses of eggs the outer envelope loses its distinctness. Sometimes the eggs are in tubes of jelly as in the toads.

Some, like peepers, lay each single egg separately while others lay several single eggs at one time. Some surface films represent the moving about of the female (like tree toad) or others, like the bullfrog mass, mean the frog remained in one position. Toads crawl about and string the file along. Spadefoots lay a band from the base of a plant to its end and then go to another plant. Most species which lay submerged masses have the whole complement in the one mass.

PLATE III. Tadpoles. 1. Florida tree frog ($\times 1$). 2, 3. Hammond's spadefoot ($\times \frac{3}{4}$). 4. Cricket frog ($\times 1$). 5. Narrow-mouthed toad ($\times 1$). 6. Mouthparts of narrow-mouthed toad ($\times 4$). 7. Toad ($\times 1$). 8. Mouthparts of bell toad (after Gaige) ($\times 2$). 9. Mouthparts of gopher frog ($\times 4$). 10. Mouthparts of solitary spadefoot ($\times 4$).

Tadpoles. Some twenty-five species of tadpoles of the United States and Canada need to be described. About ten of these have been found but were not described, and the tadpoles of fifteen forms are yet unknown to science. The life histories of the robber frogs we know in our country indicate no free tadpole stage, the whole development being in the egg.

In discussing the size of tadpoles in previous publications and in this work we consider quite small to be 1 inch (24 mm.) or smaller, small to be $1-1\frac{2}{5}$ inches (24-35 mm.), medium, $1\frac{3}{5}-2$ inches (40-50 mm.), large, $2\frac{2}{5}-3\frac{2}{5}$ inches (60-86 mm.), quite large, $3\frac{4}{5}-4$ inches (95-100 mm.), very large, $5\frac{2}{5}-5\frac{4}{5}$ inches (135-145 mm.). Some of the toads and swamp cricket frogs may have tadpoles a little less than 1 inch (23 or 24 mm.) while bullfrogs may have tadpoles $5\frac{4}{5}$ inches (145 mm.) or even larger.

The tadpole has a body and a tail. The body has sensory lines, a breathing pore or spiracle, a vent or anus, eyes, nostrils, and a

mouth. The mouth is wholly unlike the adult mouth. It has usually a disc called a labium (with upper and lower labia). Usually about the edge of the labium are tubercles or papillae. At the inner edge of each labium or at the very portal of the mouth opening itself are horny crescents called upper and lower mandibles. On the upper and lower labia are horny ridges of teeth or combs for scraping food. The tail has two parts: the axis consists of muscle segments; and the fin consists of upper and lower crests.

The narrow-mouthed toad tadpole has no mouth disk, no labial teeth, no papillae, no horny beak. The spiracle is next to the vent. The eyes are on a lateral ridge. These tadpoles are small black flattened creatures with some white on the tail axis or body.

The ribbed toad (*Ascaphus*) has a mouth disk, an upper mandible only, papillae on the lower lip or labium, upper labial teeth at least two rows to a ridge, labial tooth ridges two to three above and seven to ten below, a spiracle in the middle of the venter nearer the hind legs than the snout, eyes straight back of and close to nostrils, dorsal, equidistant from mid-dorsal line and lateral outline when viewed from above. The tail is spatulate and rounded as in some mountain stream tadpoles. The tadpoles are black or brown.

The spadefoots have the vent in the middle position, the spiracle below the body axis and on the left side, the papillae completely around the labium except for a small interval above (absent in one species), the papillary border not emarginate on the side, labial teeth three to six ridges above and four to six ridges below, eyes dorsal nearer mid-dorsal line than lateral outline, muscle segments of the tail plainly visible.

The toads usually have small blackish tadpoles with anus median, papillae confined to the sides of the labium, upper and lower edges of the labium toothed, sides of labium emarginate, labial teeth two ridges above and three ridges below, eyes dorsal slightly nearer the lateral outline than mid-dorsal line. The spiracle is on the left side and is small.

The frogs have medium to large tadpoles, with spiracle on the left side, vent on right side of lower tail fin's base. The spiracle is near the body axis; the papillary border is emarginate on the side; the labial teeth are two or three ridges or more above and three or four or more below. Some may have spatulate tails, if high mountain forms, others may have upper tail crest high and far on to the body like a tree frog tadpole, but most have the tail crests neither very high nor extending far on the body.

The treefrogs have small or medium tadpoles often with high dorsal tail crest extending far on the body, the vent on right side of ventral tail crest, and the spiracle on left side near the body axis. Labial teeth two ridges above and two or three below.

PLATE IV. Development of the gopher frog, *Rana aesopus*.

1. Egg mass ($\times \frac{1}{5}$). 2. Eggs ($\times \frac{4}{5}$). 3-7. Tadpoles ($\times \frac{5}{8}$). (4. Lateral lines and spiracle; 5. two legs; 6. three legs; 7. four legs.) 8. Transformed frog ($\times \frac{5}{8}$). 9. Adult ($\times \frac{1}{4}$).

Development and transformation. Some frogs have limited breeding periods and other species may breed almost any month in the year. The males usually precede the females to the water and croak vigorously during breeding time. The male with its forearms seizes the female. In almost all frogs the eggs are fertilized just at or slightly after the extrusion of the eggs. At first no envelopes about the eggs are apparent and the egg mass may feel soft and sticky. After a few minutes this substance absorbs water and each egg is then revealed with its vitelline membrane and one or more jelly envelopes.

The eggs hatch in 3 to 25 days, depending on temperature and other conditions. At hatching, the larva has a distinct neck, with a prominent head and body. The tail is very small or absent. On the ventral side of the head is an invagination or depression which is to be the mouth. Behind this comes the ventral adhesive disk or



disks, which help the little creature to attach itself to the egg mass or to hang itself upon some plant. In front of the mouth are two deep, dark

pits which later become the nostrils. On either side of the head appear swellings which become the external gills. The eyes do not yet appear.

As development goes on the external gills appear as branched organs, two or three on a side; the eye shows as a ring beneath the skin; and the tail grows and presents a middle muscular portion where the muscle segments clearly show. This middle part supports a thin, wafer-like tail-fin the parts of which are called, respectively, the lower and upper crests. The nasal pit shifts in position and becomes the nostril, and the vent opens. The mouth appears, and dependence on the yolk of the belly ceases. Soon the external gills begin to disappear, a lateral flap or fold of skin connects the head with the body, and the neck region disappears. Beneath this fold internal gills develop. Usually on the left side, but on the middle line in the belly in ribbed frogs and narrow-mouthed toads, the flap does not close completely, but leaves an opening, the spiracle. The water passes into the mouth over the internal gills and out of this hole. On the mouth a membranous, fringed lip, with upper and lower portions (labia) comes into being. At the portal are horny jaws or mandibles. On the upper and lower portions are ridges of horny teeth. The eyes are no longer covered pigmented rings, but are now at the surface. The intestine has become much elongated and coiled, and in some can be seen through the skin. The skin of the back and head comes to have a series of sense organs (or lateral line dots).

The buds of the hind limbs begin to appear. The fore limbs start to develop beneath the skin. When the hind limbs have reached considerable size, the left arm comes out through the spiracle, or the skin breaks down and later the right arm breaks through the skin or the skin weakens for its egress. Normally it is held that the left arm comes out first. Often the right arm appears first.

The process of transformation is now on. The tail crests decrease in size and the creature begins to live on its tail—that is, to absorb it. The gills vanish, and the lungs begin to serve as the sole respiratory organs, if the skin be not considered. The tadpole appears more and more at the surface or near the shore. The eye assumes eyelids. The tadpole mouth fringe, with its horny jaws and horny teeth, is discarded, and a true frog mouth begins to appear. The long intestine becomes wonderfully shortened, for a carnivorous diet, and the small frog, with a vestige of a tail, is ready to leave the water. This process is termed transformation or metamorphosis.

Notes. These are customarily from our field notes. They treat of habitats, general habits, or breeding, sometimes of experiences in collecting the frogs, or of their enemies or their usefulness and associated ecological features. Occasionally, you will find comparisons with closely related forms. In a difficult group such as that of the swamp cricket frogs (*Pseudacris*) a description from life, using Ridgway's color code, is given under each species.

In this work, we have quoted from some forty-five or fifty workers, and most of these excerpts appear under this caption of *Notes*. These will show some of the contributors to the study of this group. These workers have very generously granted us permission to quote from their pertinent published works. To the numerous specialists, scientists, friends and old students who helped us to acquire or to examine specimens for a monograph, we also acknowledge indebtedness in this volume. Finally, to the publishers we extend our gratitude for helpful suggestions made both before and during the printing of this volume.

Key to Families



FIG. 1. American bell toad. *Ascaphus truei*. 1. Short anal tube of female. 2. Light band across head. 3. Rear of femur. 4. Tail of male, extending from ventral side of body. 5. Vent. 6. Horny excrescences, (secondary breeding characters) of the male.

- A. Male with tail-like process; female with short anal tube; no tympanum; pupil elliptically vertical; upper jaw toothed; short ribs present; light band across head; size small, 1 1/8-2 inches (28-51 mm.).

Ribbed toads. *Discoglossidae*. Plate V.

- AA. Male without tail; female without short anal tube; ribs absent.

- B. Waist wide; body broad and thick; hind limbs short.

- c. With transverse fold of skin across head behind eyes; size small, 3/4-1 5/8 inches (19-41 mm.); no tympanum; no parotoids; snout pointed; head narrow; fingers and toes without webs except slight in *Hypopachus*; eyes small and depressed.

Narrow-mouthed toads. *Brevicipitidae*.
Plates LXXIX-LXXXI.

cc. Without transverse fold of skin across head, behind eyes; size medium to large, 1 1/2-8 4/5 inches (37-220 mm.), except *B. debilis* and *B. quercicus* (2/3 inch); tympanum distinct or indistinct; parotoids present except in 2 species of *Scaphiopus*; feet with extensive fleshy webs; snout blunt; eyes large; head broad.

D. Pupil vertical (by day); parotoids absent in 2 species, present but rounded and indistinct in 1 species; sole without subarticular tubercles; skin relatively smooth; venter smooth; no cranial crests; males without discolored throats.

Spadefoots. *Scaphiopodidae*. Plates VI-VIII.

DD. Pupil not vertical; parotoids present and elevated; sole with subarticular tubercles; skin warty; venter usually granulated; cranial crests present in most species, lacking in *Bufo boreas*, *B. canorus*, *B. compactilis*, *B. debilis*, *B. punctatus*; males usually with discolored throats.

Toads. *Bufo* *idae*. Plates IX-XXIV.

BB. Waist narrow; body narrower and thinner; hind limbs long; no parotoid.

c. Disks on digits; neither thumb nor other fingers enlarged in male.

D. Disks transverse; venter usually smooth; subarticular tubercles saw-toothed; eggs large; male throat not discolored.

Robber frogs. *Leptodactylidae*. Plates L-LV.

DD. Disks round, large or small; pupil elliptically horizontal; subarticular tubercles rounded; venter usually granular or areolate; male throat discolored.

Tree frogs. *Hylidae*. Plates XXV-XLIX.

cc. No disks on digits; extensive webbing on toes; thumb of male enlarged at base; venter smooth.

True frogs. *Ranidae*. Plates LVI-LXXXVIII.

Spadefoots. Scaphiopodidae: Scaphiopus



FIG. 2. 1. Wide interorbital space. 2. Upper eyelid. 3. Small round parotoids. 4. Fleshy webs. 5. Broad waist. 6. Pectoral glands. 7. Vertical pupil. 8. Two metatarsal tubercles, the outer large and with a cutting edge.

A. Parotoid absent or indistinct; tympanum indistinct; no pectoral gland.

B. Hind limb longer (.78-.96 in L.); fore limb longer (1.51-2.19 in L.); fourth finger longer (6.28-8 in L.); foot with tarsus longer (1.57-1.76 in L.); fourth toe longer (2.66-3.29 in L.); size small 1 1/2-2 2/5 inches (37-61 mm.); back uniform or with light bands.

Hammond's spadefoot. *Scaphiopus hammondii*. Plate VII.

BB. Hind limb shorter (.89-1.15 in L.); fore limb shorter (2-2.31 in L.); fourth finger shorter (8-11.2 in L.); foot with tarsus shorter (1.7-2.35 in L.); fourth toe shorter (3.02-4 in L.); size larger 1 7/8-3 1/5 inches (48-80 mm.); back greenish, more or less marbled with light.

Couch's spadefoot. *Scaphiopus couchii*. Plate VI.

AA. Tympanum distinct; parotoid distinct; pectoral glands present, size 2-2 7/8 inches (50-72 mm.).

Scaphiopus holbrookii. Plate VIII.

[B. Head to angle of mouth smaller (3.14-3.81 in L.); width of head smaller (2.58-2.66 in L.); snout smaller (5.4-6.3 in L.); tympanum smaller (11.5-16 in L.).

Hurter's spadefoot. *Scaphiopus holbrookii hurterii*.]

- BB. Head to angle of mouth greater (2.93-3.56 in L.); width of head greater (2.24-2.75 in L.); snout larger (5.17-6.6 in L.); tympanum greater (10.1-12 in L.); skin relatively smooth with two or more evident light dorsal stripes.

Solitary spadefoot. *Scaphiopus holbrookii holbrookii*.

- [c. "Great amount of white on back, flanks and upper surface of limbs; vermiculated irregular white bands."

Key West spadefoot. *Scaphiopus holbrookii albus*.]

Toads. Bufonidae: Bufo



FIG. 3. 1. Parotoid. 2. Tympanum (ear). 3. Warts at angle of mouth. 4. Gland on femur. 5. Glands on tibia. 6. Two metatarsal (sole) tubercles. 7. Two metacarpal (palmar) tubercles. 8. Crests united forming a prominent raised boss between the eyes. 9. Canthus rostralis. 10. Canthal crest. 11. Preorbital crest. 12. Supraorbital crest. 13. Postorbital crest. 14. Preparotoid crest. 15. Parietal crest. 16. Folds of skin of lower throat of male, covered at periods of rest by the lapette (17). 17. Lapette or apron at rear of throat of male. 18. Interparotoid interval.

A. Gland on leg; fold skin on tarsus; warts at angle of mouth.

B. Crests curved around rear of eye; size large, $3\frac{1}{5}$ – $6\frac{3}{5}$ inches (80–165 mm.); skin smooth; head broad (2.2–2.8 in L.); color uniform; glands conspicuous on both tibia and femur; tympanum medium (12–15 in L.).

Colorado River toad. *Bufo alvarius*. Plate IX.

BB. Crests absent; gland on tibia only; pitted warts on back; tympanum small (14–26 in L.).

c. Dimorphic; interparotoid interval less than width of gland; parotoid and leg gland obscured by pattern; skin smooth; male uniform green; female spotted; size small 2–3 inches (50–75 mm.).

Yosemite toad. *Bufo canorus*. Plate XIV.

cc. Not dimorphic; parotoids widely separated, interval greater than width of gland; parotoid and leg glands evident; size medium to large $2\frac{1}{4}$ –5 inches (56–125 mm.). *Bufo boreas* (2 subspecies).

D. Eyelid narrower (11.8–14.6 in L.); eye smaller (9.4–11.7 in L.); head narrower (2.66–3.1 in L.); “spread of hind foot from end of first toe to the fifth toe more than 36% of length.” (Storer)

Northwestern toad. *Bufo boreas boreas*. Plate XI.

DD. Eyelid wider (9.3–12 in L.); eye larger (8.2–10.5 in L.); head wider (2.4–2.85 in L.); “spread of hind foot . . . less than 36% of . . . length.” (Storer)

California toad. *Bufo boreas halophilus*. Plate XII.

AA. No gland on leg; no fold of skin on tarsus.

B. Femur almost entirely enclosed in body skin; vocal sac elliptical (sausage); 2 sole (metatarsal) tubercles with cutting edge.

c. Crests prominent; boss on snout; interorbital narrow (11–19 in L.)—less than internasal; mid-dorsal stripe and light bordered large dark spots (sometimes small spots).

Great Plains toad. *Bufo cognatus*. Plate XV.

cc. Crests absent; interorbital broad (9.7–11.7 in L.)—greater than internasal; drab with small dull citrine spots.

Spadefoot toad. *Bufo compactilis*. Plate XVI.

BB. Half or more of femur free from body skin; outer metatarsal tubercle without cutting edge.

c. Parotoids oval to elongate (sometimes triangular in *Bufo quercicus*).

D. Crests absent or obscure; parotoids broadly oval, divergent; interorbital broad (9.4–11.8 in L.), narrowing forward.

Southern California toad. *Bufo californicus*. Plate XIII.

DD. Crests present.

E. Size small $3/4$ – $1\ 1/4$ inches (19–32 mm.) vocal sac a sausage; mouth small (4–4.6 in L.); tympanum small (14–20 in L.); snout long (5.7–7 in L.); yellow stripe down mid-back; many red tubercles.

Oak toad. *Bufo quercicus*. Plate XXII.

EE. Size greater $1\ 5/8$ – $4\ 3/4$ inches (40–118 mm.).

- F. Mouth small (4.1-4.7 in L.); tympanum small (14-22 in L.); head narrower (2.5-3.1 in L.); head shorter (3.4-3.9 in L.); crests, a boss, from snout to rear of eye, with sides parallel.

Canadian toad. *Bufo hemiophrys*. Plate XIX.

- FF. Mouth large (3.3-4.3 in L.); tympanum large (10-18.2 in L.); head wider (2-3 in L.).

- G. Crests prominent with knobs in rear; skin finely and evenly roughened with tubercles between larger warts; red, gray or black.

Southern toad. *Bufo terrestris*. Plate XXIII.

- GG. Crests low; paired spots of darker color down back, superciliary crests meeting postorbital at right angles.

- H. Small uniform warts on back; several warts in each dark dorsal spot; dark pectoral spot; no preparotoid longitudinal crests; under parts usually unspotted; back greenish; size smaller 2-3 1/4 inches (51-82 mm.).
Fowler's toad. *Bufo fowleri*.

Plate XVIII.

- HH. Large dorsal warts; single wart in each dark dorsal spot; under parts spotted or plain.

- I. Many warts spiny, particularly on hind legs; parotoids parallel, closest together at midpoint; parotoid on dorso-lateral line or on dorsum; no boss, preparotoid longitudinal crest present.

American toad. *Bufo americanus americanus*. Plate X.

- J. Brilliant coloration; long, narrow parotoids; greater width between parallel cranial crests; hind limbs shorter; ventral granulation smooth.

Hudson Bay toad.

Bufo americanus copei.

- II. Warts round; parotoids slightly divergent at rear, and on lateral aspect; parotoids usually in contact with postorbital crest; often with boss on nostril with crests extending backward.

Rocky Mt. toad. *Bufo woodhousii*. Plate XXV.

- cc. Parotoids round or triangular; sole (metatarsal) tubercles round, small, non-cutting; dorsal pattern without the 4-6 paired spots (of the *B. americanus*, *fowleri*, *terrestris*, *woodhousii*, etc. group).

- D. Crest prominent; size large 2-8 $\frac{4}{5}$ inches (50-220 mm.); parotoid subtriangular.

- E. Parotoid as large as or larger than side of head, divergent, not bicolored; toes $\frac{1}{2}$ - $\frac{2}{3}$ webbed; crests not trenchant and top of head not a deep valley; brown with some black, yellow, red, olive; with or without black spots on a light vertical line.

Marine toad. *Bufo marinus*. Plate XX.

- EE. Parotoid much smaller, not as large as side of head, not divergent, bi-colored; row of light conical tubercles on side, body flat; toes $\frac{1}{3}$ webbed; crest high trenchant and top of head a deep valley; brown or blackish brown with light olive, buff or cinnamon area down back and a similar band or stripe on either side.

Mexican toad. *Bufo valliceps*. Plate XXIV.

DD. Crests absent or obscure; male excrescences on first two fingers not prominent; size small, below 3 inches (45 mm.).

E. Parotoids large, low, descending on side, as long as side of head; body rounded; head narrower (2.7–2.85 in L.); snout distinctly pointed and protruding; foot with tarsus short (2–2.4 in L.); size small 1–1 $\frac{4}{5}$ inches (26–46 mm.); green or gray.

Little Green toad. *Bufo debilis*. Plate XVII.

EE. Parotoids small, raised, rounded; body flat; head broader (2.3–2.6 in L.); snout not distinctly protruding; canthus rostralis prominent; foot with tarsus medium (1.66–1.88 in L.); size medium 1 $\frac{3}{5}$ –3 inches (40–74 mm.); red to gray.

Canyon toad. *Bufo punctatus*. Plate XXI.

Tree Frogs. Hylidae: Acris. Pseudacris. Hyla



FIG. 4. 1. Tympanum (ear). 2. Tympanic fold. 3. Snout (muzzle). 4. Plaits on throat of male. 5. Pectoral fold across breast. 6. Tarsal fold. 7. Small adhesive disks. 8. Large adhesive disks. 9. Prepollex. 10. Rear of casque (skin fastened to skull) outlines rear of head.

- A. Alternating dark and light bands on rear of thigh; oblique white stripe from eye to shoulder; vertical dark and light bars on upper jaw; white margined triangle between eyes; hind leg very long (.55-.62 in L.); tibia very long (.5-1.7 in L.).
Cricket frog. *Acris gryllus*. Plate XXVI.
- AA. No alternation of dark and light bands on rear of thigh; triangle between eyes if present not white margined; no alternation of dark and light bars on upper jaw.
 - B. No dark, brown, black or plum-colored stripe in front of or behind eye.
 - C. Head skin attached to skull; thumb rudiment apparent; rear of femur reticulated; no light jaw spot or dark bar between eyes; disks very large; size large $2 \frac{3}{5}$ - $5 \frac{1}{5}$ inches (64-130 mm.).
Giant tree frog. *Hyla septentrionalis*. Plate XLVII.
 - CC. Head skin not grown to skull; no thumb rudiment; rear of femur unspotted.
 - D. Rear of thigh purple; no interorbital bar between eyes; throat with green on either side.
 - E. Green of female's throat not edged with white; back smooth green; body slender (head's width 3 to 3.6 times in length).
 - F. Yellow or white line along side and on upper jaw; tibia 1.7-1.95 times in length of body; 3rd finger longer (3.3-4 in L.).
Green tree frog. *Hyla cinerea cinerea*. Plate XL.

FF. No yellow or white line along side or on upper jaw; tibia 1.95–2.1 times in length of body; 3rd finger shorter (4.5–5.4 in L.).

Miller's tree frog. *Hyla cinerea evittata*. Plate XLI.

EE. Green of female's throat edged with white; back usually granular and dark spotted; body stout (head's width 2.3–2.8 times in length of body); white stripe from tip of snout along upper jaw backward.

Florida tree frog. *Hyla gratiosa*. Plate XLV.

DD. Rear of thigh orange or ocher; interocular bar present; throat without green on either side.

E. Light stripe below eye to shoulder; back black, green or brown, spotted or not; smooth; 1st finger 7–9.3 in L.; 1st toe 7–14 in L.; interorbital space 8–9.3 in L.

Squirrel tree frog. *Hyla squirella*. Plate XLVIII.

EE. No light stripe on upper jaw or light spot below eye; brown or gray usually spotted; large disks; 1st finger 5.1–6.5 in L.; 1st toe 5.5–8.8 in L.; interorbital space 9–10.6 in L.

Canyon tree frog. *Hyla arenicolor*. Plate XXXVII.

BB. Dark, brown, black stripe or band in front of or behind eye or both.

c. Rear of thigh spotted.

D. White-edged, plum-colored band from eye to groin; back green unspotted with dark; rear of femur with deep orange spots; no interorbital bar; throat with green on either side, green white edged in female.

Anderson's tree frog. *Hyla andersoni*. Plate XXXVI.

DD. No plum-colored band; interocular bar present; back usually with spots.

E. Network of black on yellow sides; broad dark vitta back from eye becoming a vertical shoulder bar; throat with greenish or yellow; rear of thigh netted with greenish yellow and purplish russet; light yellow or green spot below eye; size large 1 3/4–3 3/5 inches (44–89 mm.).

Mexican tree frog. *Hyla baudinii*. Plate XXXIX.

EE. No network of black on yellow sides; no black or brown shoulder bar; throat not prominently greenish; medium to small.

F. Rear of thigh brown, no netted pattern.

G. Rear of thigh with distinct round or elliptic orange yellow spots; no light spot below eye; a cross-shaped spot on back.

Piney's woods tree frog. *Hyla femoralis*.

Plate XLIV.

[GG. Rear of thigh specked with yellowish brown and darker brown; three rows of approximated spots on back or cruciform spot; light spot below eye present or absent.

Dusky tree toad. *Hyla versicolor*

phaeocrypta.]

FF. Rear of thigh netted with black or dark; light spot below eye.

G. Rear of thigh with green in network; groin greenish; cross on back in center or rear of back; back less rough; intertympanic space 2.6-3.2 in L.; internasal space 8-10 in L.; 3rd finger 2.9-3.2 in L.

Whistling tree frog. *Hyla avivoca*.

Plate XXXVIII.

GG. Rear of thigh with orange in network; groin orange; cross on forward half of the back; skin commonly rough; intertympanic space 3-3.8 in L.; internasal space 9-12.5 in L.; 3rd finger 3.2-4.8 in L.

Common tree toad. *Hyla versicolor*.

H. Dorsal surfaces smooth; "a number of subcircular golden spots in the brown ground on rear of thighs; interspaces (on rear of femur) often reduced to small circular spots."

Cope's tree frog. *Hyla versicolor chrysoscelis*. Plate L.

HH. Dorsal surfaces rough; "brown reticulation on yellow ground of the posterior face of the thighs"; "more fully marbled with yellow and brown, even covering the whole inner face of the tibia and the light interspaces more or less angular."

Hyla versicolor versicolor. Plate XLIX.

cc. Rear of thigh unspotted; usually a transverse bar or triangle or median longitudinal line between eyes.

D. A narrow oblique cross on back; rear of thigh olive ocher or raw sienna; no prominent lateral dark stripe.

Peeper. *Hyla crucifer*. Plate XLII.

DD. No oblique cross on back; usually a triangle or spot between eyes or median dark longitudinal line; dorsal and vittal stripes or rows of spots.

E. Size very tiny $2/5$ – $5/8$ of an inch (11.5–17.5 mm.); three dorsal stripes usually but not always absent; stripe from eye backwards usually present; very long hind legs (.53–.64 in length of body); tibia very long (1.5–2.1 in L.).

Little chorus frog. *Pseudacris ocularis*.

Plate XXXIII.

EE. Size small $3/4$ of an inch to $1\ 7/8$ inches (19–48 mm.); 4 or 5 dark stripes or rows of spots usually present; hind limb .62–.87 in L.

F. Five stripes or rows of spots usually present; size small; disks inconspicuous.

Swamp cricket frog. *Pseudacris nigrita*.

5 subspecies.

Plates XXVIII–XXXII.

FF. Four stripes or rows of spots.

G. Vittal stripe slender; dorsolateral bands curved sometimes making a cross or transverse bar on back; hindlegs long (.60–.67 in length); triangle between eyes; disks distinct.

Pseudacris brachyphona. Plate XXVII.

GG. Vittal mask white bordered above; vittal stripe darker than other stripes or rows of spots; hind leg .62-.87 in L.

H. Body broad, toad-like (1.75-2 in length); discs inconspicuous; vitta ends at shoulder; hind limbs shorter (.73-.87 in length).

Texas ornate chorus frog.

Pseudacris streckeri. Plate XXXV.

H. Body narrow (1.94 in L.); hind limbs longer (.62-.78 in L.).

I. Discs inconspicuous; dark mask ending beyond shoulder sometimes to groin; oblique groin spots light bordered; interorbital space narrow (8.8-14.4 in L.).

Ornate chorus frog. *Pseudacris ornata*. Plate XXXIV.

II. Discs distinct; interorbital wide (7.2-10 in L.); no light borders around groin spots if present.

J. Vitta may extend some distance along the side; interocular triangle or bar absent; dark spot on each eyelid usually present; a pair of dark longitudinal post-sacral bars or spots—the conspicuous dorsal marking; tympanum smaller (14.4-20 in L.); first finger shorter (7.2-10 in L.); first toe shorter (7-13.3 in L.).

Hyla eximia. Plate XLIII.

- JJ. Vitta commonly ends at shoulder; interocular triangle usually present; no very distinct post-sacral bars; the dorsal spotting often quite pronounced and varied; tympanum larger (11-14 in L.); first finger longer (5.6-8 in L.); first toe longer (5.6-8.8 in L.).

Pacific tree frog. *Hyla regilla*. Plate XLVI.

Robber Frogs. Leptodactylidae: Leptodactylus. Eleutherodactylus. Syrrhophus

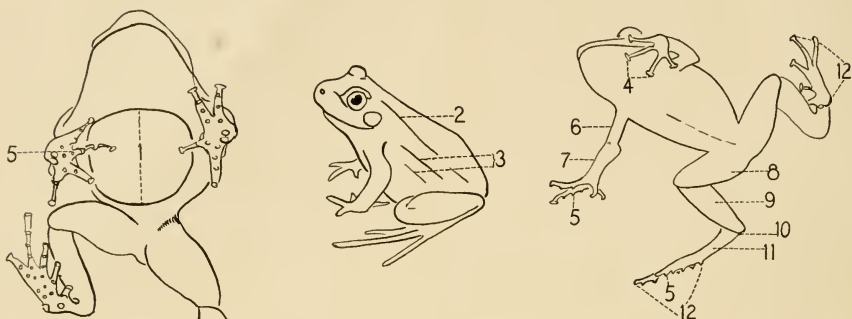


FIG. 5. 1. Ventral disk. 2. Dorsolateral fold. 3. Lateral folds. 4. Transverse (T shaped) disks. 5. Subarticular tubercles sharp and saw toothed. 6. Brachium (upper arm). 7. Antebrachium (forearm). 8. Femur. 9. Tibia. 10. Heel. 11. Tarsus. 12. Foot.

A. Pupil horizontal; tympanum distinct.

- B. Fingers and toes free without distinct terminal disks; size small 1 2/5-2 inches (35-49 mm.); white or cream stripe on upper jaw; vittal stripe from nostril to tympanum; dorsal color gray with irregular dark spots; dorsolateral fold and a lateral fold below it.

White-lipped frog. *Leptodactylus albilabris*. Plate LIV.

- BB. Tips of phalanges T shaped; toes and fingers free; terminal disks small; no white upper jaw stripe; no dorsolateral or lateral fold.

- c. Size large 1 7/8-3 3/5 inches (48-90 mm.); a ventral disk; voice a resounding bark; head broad (2-2.57 in L.); head wider than head to tympanum; eye small (7.2-9.25 in L.); eye much less than first finger; fingers larger; light stripe down middle of back; intertympanic fold (in preserved material).

- d. Fourth toe longer; fairly closely aggregated black blotches; sides and hinder half of abdomen faintly areolate; skin in adults on dorsum stiff, coarse, areolate. Belly without vermiculations or spots; back covered with large black spots.

Texas cliff frog. *Eleutherodactylus latrans*. Plate LII.

[DD. Fourth toe shorter; upper parts either green or with scattered tubercles; belly with faint spots; broad light transverse band across back just back of forelimbs.

Mexican cliff frog. *Eleutherodactylus augusti*. Plate LI.]

cc. Size small $3/5$ – $1\ 3/5$ inches (15–39.5 mm.); without ventral disk; voice a cricket-like chirp; head narrower (2.66–3.38 in L.); head usually narrower than head to tympanum; eye larger (5–8 in L.), eye greater than 1st finger; fingers smaller.

D. Usually a light stripe from eye backward along dorsolateral region; a light transverse band between eyes; toes longer; forelimb shorter (1.7–2 in L.); foot with tarsus longer.

Ricord's frog. *Eleutherodactylus ricordii*. Plate LIII.

DD. Usually without light dorsolateral stripe from eye backward; usually no transverse band between eyes; toes shorter; forelimb longer (1.45–1.88 in L.).

E. Tympanum smaller (11–13 in L.); hind limb shorter (.72–.87 in L.); internasal broader (8–9 in L.); forelimb usually greater than foot with tarsus.

Marnock's frog. *Syrrhophus marnockii*. Plate LVI.

EE. Tympanum larger (8–10 in L.); hind limb longer (.72–.73 in L.); internasal shorter (9–10 in L.); forelimb usually less than (rarely equal to) foot with tarsus.

Camp's frog. *Syrrhophus campi*. Plate LV.



Frogs. Ranidae: *Rana*



FIG. 6. 1. Nostril. 2. Internasal space. 3. Costal (dorsolateral) fold. 4. Enlarged thumb of male. 5. Enlarged tympanum of male. 6. Tympanum of female. 7. Tympanic fold. 8. Fleshy fold on jaw. 9. Glandular folds on tibia. 10. Sacral hump. 11. Full webbing of male bullfrog. 12. Narrow interorbital space. 13. Intertympanic space.

A. Tympanum larger than eye in male, equal in female (rarely smaller in *R. virgatipes*) (5.6–12.5 in L.); throat of male differently colored; upper jaw unicolor; no black mask; no light jaw stripe; no regular dorsal rows of spots; no pronounced yellow, orange or red on undersides of hind legs or on belly or groin; tibia 1.8–2.6 in L.

B. Rear of femur with alternation of light and dark horizontal bands; dorsolateral folds absent; edge of jaw uniform.

C. Size small 1 $\frac{5}{8}$ –2 $\frac{5}{8}$ inches (41–66 mm.); usually a light yellowish dorsolateral stripe extends back from eye; two joints of fourth toe free of web; vocal sacs of male like a marble on either side of head; intertympanic space 3.42–4.4 in L.; foot with tarsus 1.36–1.56 in L.

Carpenter frog. *Rana virgatipes*. Plate LXXIX.

CC. Size large 3 $\frac{1}{4}$ –8 inches (82–200 mm.); no or only one joint of fourth toe free of web; back uniform in color; no vocal sacs in males on side of head.

D. Alternation of color on rear of femur conspicuous; first finger generally less than second finger; intertympanic space narrower (5–6.8 in L.); foot with tarsus shorter (1.4–1.67 second; in L.).

Southern bullfrog. *Rana grylio*. Plate LXVII.

- DD. Alternation of color on rear of femur not conspicuous; 1st finger generally equal to 2nd; intertympanic space wider (4.5-5.2 in L.); foot with tarsus greater (1.28-1.53 in L.).

Bullfrog. *Rana catesbeiana*. Plate LXV.

- BB. Rear of femur without alternation of light and dark horizontal bands; edge of jaw mottled, barred, or uniform.

- c. Dorsolateral fold absent; size large $3 \frac{1}{4}$ - $5 \frac{1}{4}$ inches (82-131 mm.); rear of femur, light or white spots on brown; edge of upper jaw mottled; head to angle of mouth 2-2.7 in L.; 1st finger 6.5-7.3 in L.

River-swamp frog. *Rana heckscheri*. Plate LXVIII.

- cc. Dorsolateral fold present, indistinct or absent; edge of upper jaw uniform or barred; size medium to small; first finger 5.-6.8 in L.; head to angle of mouth 2.7-3.4 in L.

- d. Dorsal folds lacking or interrupted; back and sides mottled or with prominent spots; rear of femur vermiculated in its spotting; males with lateral external vocal sacs somewhat developed; size small $1 \frac{7}{8}$ -3 inches (48-76 mm.); third toe 2.5-2.9 in L.; interorbital space 19-28 in L.

Mink frog. *Rana septentrionalis*. Plate LXXV.

- DD. Dorsal fold on cephalic half only; cheek green with mottled jaw below; back uniform or with fine black specklings; rear of femur with fine and scant specklings; males with no lateral external vocal sacs; size medium 2-4 inches (52-100 mm.); third toe 2.7-3.7 in L.; interorbital space 11-23 in L.

Green frog. *Rana clamitans*. Plate LXVI.

- A. Tympanum of male not enlarged (enlarged in *R. onca*, rarely in *R. areolata* and *R. sphenoccephala*) smaller than eye (9-19 in L.); throat not so differently colored in males; upper jaw with light stripe or mottling of light and dark; a vitta or regular spots between dorsolateral folds or with yellow, orange or red on hind legs, groin or belly; tibia 1.4-2.3 in L.

- B. Dorsolateral folds absent or indistinct, low, broken; under surface of hind legs yellow; skin rough; no vitta.

- c. Size larger 2 $1/3$ -4 $1/2$ inches (58-115 mm.); no outer sole (metatarsal) tubercle; no stripe on upper jaw; throat and lower jaw uniform or cloudy; hind legs shorter (.65-.69 in L.); tibia shorter (1.86-2 in L.).

Rana tarahumarae. Plate LXXVIII.

- cc. Size smaller 1 $3/5$ -3 $3/8$ inches (39-84 mm.); outer sole (metatarsal) tubercle; stripe on upper jaw present or obscure; throat and lower jaw spotted; hind legs longer (.57-.66 in L.); tibia longer (1.61-1.88 in L.).

Yellow-legged frog. *Rana boylii*. Plates LXI-LXIII.

- bb. Dorsolateral folds distinct full length of body (folds not conspicuous in *R. aurora*.)

- c. With mask to angle of jaw (sometimes less conspicuous or absent in *R. aurora*); males with no external vocal sacs between ear and shoulder; rear of femur finely dotted and without heavy spots.

- d. No red or yellow on the under parts; mask black; size small 1 $1/6$ -3 $1/4$ inches (29-82 mm.); tympanum larger (11-15 in L.).

- e. Dorsal color usually a mid-band of darker color within light dorsolateral folds; mid-dorsal light stripe present or absent; breast more spotted. Hind leg short (.62-.75 in L.); tibia short (1.93-2.3 in L.); tibia usually equals foot.

Northern wood frog. *Rana cantabrigensis*. Plate LXIV.

- ee. Dorsal color between dorsolateral fold usually like dorsum; no mid-dorsal stripe; breast usually without spots; hind leg long (.53-.62 in L.); tibia long (1.6-1.88 in L.); tibia longer than foot.

Wood frog. *Rana sylvatica*. Plate LXXVII.

- dd. Some red or yellow on the under parts; size larger 1 $4/5$ -3 $4/5$ inches (45-95 mm.).

- e. Mask brown; inky spots on back sometimes light centered; white stripe from snout to shoulder; tympanum small (14-19 in L.).

Western spotted frog. *Rana pretiosa*. Plate LXXIV.

EE. Mask black (sometimes absent); white stripe from eye to shoulder or shorter.

F. Skin smooth; dorsolateral folds distinct; dorsum dotted or without spots; head to tympanum in width of head .91-1.03; size smaller 1 3/4-3 1/2 inches (44-87 mm.).

Oregon red-legged frog. *Rana aurora aurora*.

Plate LIX.

FF. Skin rough; dorsolateral folds distinct; dorsum with dark light-centered spots; head to tympanum in width of head .98-1.25; size larger 2 1/3-5 2/5 inches (58-136 mm.).

California red-legged frog. *Rana aurora*

draytoni. Plate LX.

cc. With no mask; males with external vocal sacs between ear and shoulder.

D. Without white line on upper jaw.

E. Upper jaw uniform or with few dashes; size small 1 3/4-3 inches (44-74 mm.); dorsum unspotted or with few spots on rear like *R. pipiens*); with yellow on under parts; males with enlarged tympana. Nevada frog. *Rana onca*. Plate LXIX.

EE. Upper jaw mottled; size larger 2 1/2-4 1/2 inches (63-113 mm.); three or four rows of spots between dorsolateral folds; males rarely with enlarged tympana.

F. Dorsal spots large, light centered; 3 or 4 cross bars on legs with small intermediates; snout shorter; head to tympanum 2.8-3.2 in L.; head to angle of mouth 3.15-3.8 in L.; eye small (9.8-12.3 in L.); intertympanic space medium (3.8-4.7 in L.).

Northern gopher frog. *Rana areolata*. Plate LVIII.

FF. Dorsal spots small, slightly light encircled; 5-8 uniform bars on hind legs; snout longer; head to tympanum 2.2-2.6 in L.; head to angle of mouth 2.5-3.1 in L.; eye large (6.8-10.2 in L.); intertympanic space broad (2.95-3.65 in L.).

Gopher frog. *Rana aesopus*. Plates IV, LVII.

DD. With white line on upper jaw.

E. No orange on under parts; dorsal spots round with interspaces of same diameter or more.

F. Snout shorter (6-6.8 in L.); more lateral spots below dorsolateral fold; tibia shorter (1.73-1.94 in L.); head to tympanum 2.8-3.2 in L.; upper eyelid wide (9.3-11.7 in L.); tympanum normally without light center.

Meadow frog, *Rana pipiens pipiens*.

Plates LXXI-LXXIII.

FF. Snout longer (5.23-6.3 in L.); fewer lateral spots below dorsolateral fold; tibia longer (1.55-1.82 in L.); head to tympanum 2.38-2.8 in L.; upper eyelid medium (11.2-14 in L.), tympanum usually with light center.

Southern meadow frog.

Rana sphenoccephala. Plate LXXVI.

EE. Orange on under parts; dorsal square spots in regular rows; spots with interspaces less than diameter of spots.

Pickerel frog, *Rana palustris*. Plate LXX.

Narrow-mouthed Toads. Brevicipitidae: Hypopachus. Gastrophryne

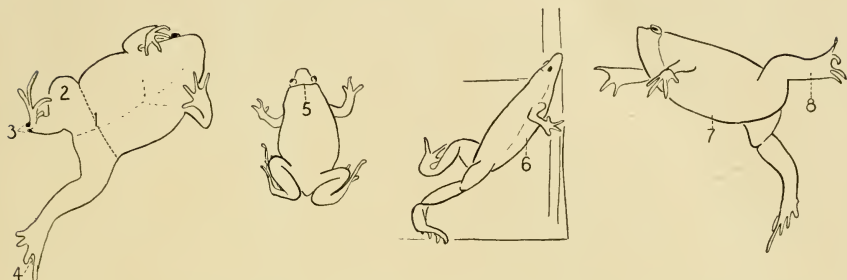


FIG. 7. 1. Broad waist. 2. Femur partially involved in body skin. 3. Two metatarsal tubercles. 4. Slight basal web. 5. Transverse fold of skin across head. 6. Depressed form of body. 7. Body thick. 8. Legs short.

- A. Two sole (metatarsal) tubercles; basal webs on feet; snout shorter (9-10 in L.); usually a mid-dorsal yellow line and mid-ventral white line; oblique white band from eye to shoulder. Taylor's toad. *Hypopachus cuneus*. Plate LXXXII.
- AA. One sole (metatarsal) tubercle; no webs on feet; snout longer (6.6-8.2 in L.); no mid-dorsal or mid-ventral lines nor oblique postorbital band.
 - B. Muzzle shorter; hind foot unusually short, hind limb short; back areolate, the posterior parts even pustular (Texas).

Mitchell's narrow-mouthed toad. *Gastrophryne areolata*.

- BB. Muzzle longer; hind limb longer.

- c. Body depressed (thickness in length 3-5.6 in males, 4-4.3 in females); tibial width in tibial length 3-4; body width in females 2.46-3.1 in L.; upper eyelid 10-18 in L.; eye 8.7-12.7 in L.; skin usually smooth; under parts white; dorsum grayish olive.

Texas narrow-mouthed toad. *Gastrophryne texense*. Plate LXXXI.

- cc. Body less depressed (2.5-3.35 in males, 2.65-3.4 in females); tibial width in tibial length 2.5-3 times; body width in females 1.83-2.3 in L.; upper eyelid 18.6-28 in L.; eye 10-14 in L.; skin smooth, tuberculate, or pustular; under parts gray, or brown speckled and mottled; dorsum black, gray or brown.

Narrow-mouthed toad. *Gastrophryne carolinensis*. Plate LXXX.

American Bell Toad. American Ribbed Toad.

PLATE V. ($\times 1$). 1, 5. Females. 2. Tadpole. 3, 4. Males.

Ascaphus truei Stejneger.

Range: Washington, Oregon into northern California, and eastward to Haugen, Montana. In 1932, Dr. A. L. Hazzard took it in 4 different places above 4000–6000 ft. in Glacier National Park. Mt. Baker National Forest (Edith Hardin, July–Aug. 1928) near the British Columbia line.

Habitat: They live in forested sections, under rocks in perennial, usually swift flowing, small mountain streams of low temperature. After heavy rains, several collectors have found them in moist woods, at varying distances from the streams.

Size: Adults, $1\frac{1}{8}$ –2 inches (Males, Length to tail 29–40 mm. Tail 3–10 mm. Females, 28–51 mm.).

General appearance: This small "toad" is gray, pink, or brown to almost black. In live material from Rainier National Park, the back of the female is grayish olive to citrine drab; the male, kaiser brown, hazel to vinaceous russet. Numerous black spots occur on the tops of the legs and on the back. The bar across the head is pale green to pale yellow; the venter, dull citrine, with belly light orange yellow with some pinkish vinaceous interspersed; the



underside of legs rose. The females are usually lighter than the males. The wood brown or cinnamon parotoid gland is well developed or may be broken into a glandular ridge along the side. The fingers are long and slender, free of webbing; the toes, slightly webbed. The head is flattened, slightly broader than long, the snout obtusely pointed, and with no visible tympanum. The skin is smooth or slightly roughened with granules, wrinkles, warts, and small tubercles. The conspicuous "tail" of the male is level with the ventral side of the body. This is $1/8$ – $2/5$ inch (3–10 mm.) long, $1/6$ – $1/5$ inch (4–5.5 mm.) broad. The anus is a large swollen orifice just back of the constricted tip. The female appears much like a tree toad.

Structure: The tail is an intromittent organ; lower jaw from below an almost perfect semi-circle; second, third, and fourth vertebrae bearing short ribs; tongue attached by broad surface, and cannot be protruded; arms of male conspicuously heavier than in the female as also are the hind limbs and feet. Breeding males with dark excrescences on the inner edge of the inner fingers, along the inner edge of the forearm and a ball-like excrescence at the base of the thumb and oftentimes with dark excrescences on each side of the breast; tubercles much finer on the rear portion of the back and on the hind legs in the female; eye large with a vertical pupil.

Voice: No vocal sac.

Breeding: Known dates are in May, June, July, August, and September. The eggs in circular masses of rosary-like strings are attached to the under side of stones in creeks. The eggs are not pigmented, few in number, and very large, $1/3$ inch (8 mm.), the yolk $1/5$ inch (5 mm.) in diameter. The tadpole is medium in size, $1\ 4/5$ –2 inches (45–51 mm.), its body round, its tail long, its crests not conspicuous. The tooth ridges are $3/10$ (upper ridges with more than one row of teeth). The period of development is probably over winter. They transform during July and August, at $3/5$ – $3/4$ inch (14–18 mm.).

Notes: Mrs. Gaige working in the Olympic region of Washington wrote: "It was under the rocks in these little creeks that *Ascaphus* lived. . . . One found them only by working slowly upstream and turning over every movable stone. . . . When placed on land they were awkward and stupid in action and appearance and made little effort to escape. They were solitary; never found more than one under a single stone and individuals were usually well separated in the stream."

Southern Spadefoot. Couch's Spadefoot. Rain

Toad. Sonoran Spadefoot. Sonora Spadefoot (*rectifrenis*). Cape St. Lucas Spadefoot (*varius*).

PLATE VI. 1, 6. Males ($\times \frac{2}{3}$). 2. Male ($\times \frac{1}{2}$). 3. Female ($\times \frac{1}{2}$). 4. Male croaking ($\times \frac{1}{5}$). 5. Eggs ($\times \frac{1}{2}$).

Scaphiopus couchii Baird.

Range: Texas to Arizona and Utah, northern Mexico and Lower California.

Habitat: They live in subterranean burrows, often under logs or similar shelter, and are nocturnal in habit. They breed in temporary pools, coming out only after heavy rains.

Size: Adults, 1 $\frac{7}{8}$ –3 $\frac{1}{5}$ inches. (Males, 48–70 mm. Females, 50–80 mm.).

General appearance: The short, fat toad-like body has the back greenish, more or less marbled with light, a dark line extending backward from each eye, which may soon join other dark lines or areas. The skin is roughly tuberculate, with many light tubercles on the sides. Both the ear and parotoid glands are indistinct. The eyes are large and protuberant with vertical pupils. The venter is whitish; the fingers and toes light, and the rear of the arm and leg with a light band. The outer sole tubercle and sometimes the tips of fingers and toes are dark.



Structure: No pectoral gland; skin on crown of head thin; tongue, subcircular, slightly emarginate; hand, nearly as long as forearm; toes fully webbed.

Voice: The chorus is harsh and noisy, a great caterwauling and can be heard a considerable distance. The individual call *wow, me ow* or *a ow*—is a most unearthly noise like someone in pain.

Breeding: The time is from April to August at periods of heavy rainfall. The eggs are in bands $1/4$ inch (6 mm.) across or cylindrical masses on plant stems, the jelly rather firm, the eggs close together, black above and creamy white below. The vitellus is $1/18$ – $1/16$ inch (1.4–1.6 mm.). In warm spots they hatch in $1\ 1/2$ days. The “bronzy” tadpole is black, dotted with old gold or fawn, small, 1 inch (24.5 mm.), broad with tail tip rounded. The tooth ridges are $4/4$, rarely $5/4$, $3/4$, $5/5$, $2/4$. After a tadpole period of 15 to 40 days, they transform during the summer months and early fall at $3/10$ – $1/2$ inch (7.5–12.5 mm.).

Notes: May 29, 1925. Comfort, Texas. The spadefoots are calling as they float spread out on the surface. Their sides are swelled out and vibrating. They often seem to curve their backs in their tremendous efforts.

June 4, 1925. In Comfort, Texas, in roadside pools where, on May 29, we found Couch’s spadefoot breeding, there are now large tadpoles. The rain came May 28. The eggs must have been laid then. How fast!

June 8, 1925. Near Dolores, Texas, we stopped beside a long roadside rain pool. It is a sandy area with scattered bushes, very little herbaceous material, and mesquite rather far apart. All stages were here, even tiny transformed ones leaving the pond. They were hopping out so thickly that they formed a seething mass, several spadefoots deep. They were gathered around small herbs, small bushes, and larger ones when possible, for shade, and generally just enough in a place to match the shadow of the plant. Many of them crawl out of the pond when they still have very long tails. I wonder if it hastens the tail shrinking.

Hammond's Spadefoot. Western Spadefoot.

Hammond's Spea. Western Spadefoot Toad. Cope's Spea (*bombifrons*). New Mexican Spea (*stagnalis*).

PLATE VII. 1. Male ($\times \frac{2}{3}$). 2. Male ($\times \frac{1}{2}$). 3. Egg masses ($\times \frac{1}{3}$). 4. Tadpole ($\times \frac{1}{2}$). 5. Transformed frog ($\times \frac{2}{3}$). 6. Female ($\times \frac{2}{3}$). 7. Male (left) and female (right) ($\times \frac{2}{3}$).

Scaphiopus hammondi Baird.

Range: North Dakota and British Columbia to Oklahoma, Texas and Mexico, west to the Pacific coast states.

Habitat: They live underground in burrows which they dig in soft earth by backing into the ground, digging with their hind feet which are armed with spades. They rock the body as they dig and the dirt falls into the burrows on top of the toads. They breed commonly in temporary rain pools or temporary overflow areas.

Size: Adults, 1 1/2-2 2/5 inches. (Males, 37.5-59 mm. Females, 37.5-61 mm.).

General appearance: The body is stout and toad-like, small in size. The eyes are large and protuberant with vertical pupils. The skin is fine, relatively smooth, dotted with fine roundish tubercles. The back is greenish, the sides yellowish glaucous or



light mineral gray or greenish. There are green spots on the back, top of head and legs. The forward under parts are white, sometimes buffy on the throat; the rear under parts purplish. The males have a wash of grayish green on either side of the throat.

Structure: Head broader than long, muzzle short and overhanging the lower jaw; epidermis on top of head thick and horny; tympanum indistinct; no parotoid gland; tongue very large, entire; no tibial or pectoral gland; hind limb, tibia, foot, 4th toe, and fingers relatively longer than in Couch's or in Holbrook's spadefoot.

Voice: The males call, lying on the surface of the water. The call is a rolling or bubbling one, a croak more like the croak of some frog than Couch's or the hermit spadefoot. The call has been described in widely different ways; as the loud purr of a cat with the metallic sound of grinding gears, as a low-toned *tirr-r-r-r*, as a loud *crah-crah-rah*, and as a resonant *ye-ow*. It has been called unusual, weird, plaintive and ventriloqual.

Breeding: They breed from mid-April to August, dependent upon heavy rainfall. The eggs are in cylindrical masses attached to grass or plant stems. The eggs on the periphery of a jelly cylinder may look stalked, the stalks $1/5$ – $3/8$ inch (5 or 6 to 9 mm.) long, and $1/16$ – $1/10$ inch (1.4–2.3 mm.) in diameter, the eggs $1/25$ – $1/16$ inch (1–1.6 mm.). They hatch in $1\frac{1}{2}$ to 2 days. The dark greenish black tadpoles may grow large, $2\frac{3}{5}$ – $2\frac{4}{5}$ inches (65–70 mm.) long. They are broad, almost round bodied in dorsal view, the eyes close together, the tail short with rounded tip, the spiracle low almost ventral. Like most spadefoot tadpoles, the musculature of the tail stands out very prominently. The tooth ridges are $5/5$, $4/4$, $3/4$, $5/4$. After a tadpole period of 30 to 40 days they transform from May 20 to September 1, at $1/2$ –1 inch (13–23 mm.). The tadpole is carnivorous in habit, and may prey on its own kind, but it is a very effective enemy of the mosquito.

Notes: July 8, 1917. Quite a rain fell near Sierra Blanca, Texas. At 7 o'clock, we heard no notes in the creek, but later from our camp one half mile away, we heard the chorus plainly and decided it must be spadefoots. We found toads and spadefoots of two species migrating from the mountain side of Sierra Blanca toward the pool and noise. . . . Along the edges of the swift stream now flowing across the flooded area we found *Scaphiopus couchii*. Their cries were catlike. The *Scaphiopus hammondi* were on the surface of the water and their calls were bubbling. . . . the Hammond's male will float like *S. holbrookii*. When he croaks, the rear half of the back dips beneath the water.

July 9. The stream has disappeared, now broken up by intermediate mud flats. The spadefoots and toads have disappeared from last night's rendezvous.

Spadefoot. Holbrook's Spadefoot. Hermit

Spadefoot Toad. Spade-
foot Toad. Hermit Toad.
Solitary Toad. Hermit
Spadefoot. Storm Toads.
Storm Frogs.

PLATE VIII. 1, 4. Males
($\times \frac{2}{3}$). 2, 3. Females ($\times \frac{2}{3}$). 5.
Egg mass ($\times \frac{1}{2}$). 6. Forearm of
male ($\times \frac{2}{3}$).

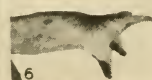
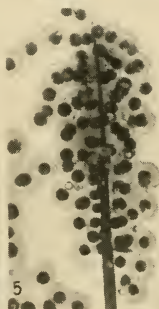
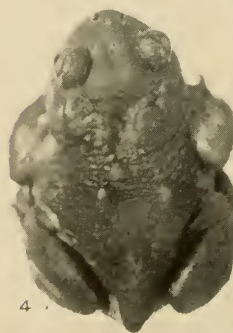
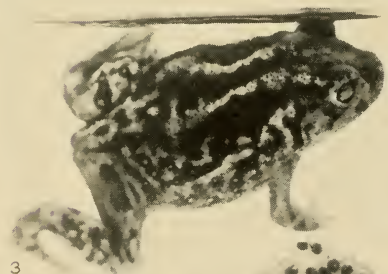
Scaphiopus holbrookii
holbrookii (Harlan).

Range: Massachusetts to
Florida, west to Texas and
Arkansas.

Habitat: Shallow burrows
in the ground. Nocturnal in
habit.

Size: Adults, 2-2 $\frac{7}{8}$
inches. (Males, 54-72 mm.
Females, 50-71 mm.).

General appearance: Like
the common toad, it is short
and broad in body, and with
small round post-tympanal
glands (parotoids). The skin
is relatively smooth but bears
scattered warts; is usually
brown in color frequently
with two more or less evident
light dorsal stripes. The arms
and legs are short and thick;
the feet, broad. The inner
tubercle of the sole is a large
dark horny process with
which it digs its burrows. The
eyes are large and protuber-
ant with vertical pupils in-
dicating nocturnal habits.
The throat and breast are
white; the lower belly is
grayish.



Structure: Tympanum much smaller than the eye; large, wide, hind feet; skin on crown of head, thin; parotoid gland present; male with a subgular vocal sac; males with fingers broader than females.

Voice: Its call is a hoarse, coarse, monosyllable, *wank*, *wank* like the calling of young crows.

Breeding: They breed from March to September at periods of heavy rainfall. The eggs are in irregular bands along grass blades or plant stems, the band 1-2 inches (25-50 mm.) wide and 1-12 inches (25-300 mm.) long, the egg $1/16$ - $1/12$ inch (1.4-2 mm.), the envelope $3/16$ - $1/5$ inch (4-5.6 mm.). They hatch in 1 $1/2$ -2 days. The bronzy tadpole is small, 1 $1/8$ inches (28 mm.) broad, but not deep, its tail short and rounded. After a tadpole period of 14 to 60 days, they transform from July to September at $1/3$ - $1/2$ inch (8.5-12 mm.).

Notes: August 16, 1922. On a detour, south of Hilliard, Florida, . . . we pitched camp on an oak ridge. An old road filled with water made a shallow pond. The spadefoots were calling here and in another similar pool and in a third deeper pool as well. The pond was filled with pairs. When ready to lay, they went to the bottom of the pond, often the male with his eyes closed, and the female with hers partly closed. When she found a stem to suit her, she seized it with her front feet and pushed with her hind feet. She walked or climbed up the stem or along it if it fell to horizontal position as she laid the eggs, the male clinging close to her back. . . . There was a strong chorus that night and by the next morning the ponds were all churned up and muddy. Many egg masses were there, but no toads.

Key West Spadefoot.

Scaphiopus holbrookii albus (Garman).

Range: Florida Keys and possibly the extreme southern part of Florida.

Size: Most of the specimens which we have seen are 54 to 56 mm. in length or 2 $1/6$ -2 $1/4$ inches.

General appearance: This is like Holbrook's spadefoot but with an excessive amount of white in the pattern. "Average size less than that of preceding (*S. h. holbrookii*). Brown of the back lacks the red or chocolate tinge. Readily distinguished by the great amount of white on back, flanks, and upper surface of limbs. The white forms spots or vermiculations which coalesce into bands of irregular shape and extent." (Samuel Garman, 1884, p. 45). A doubtful subspecies.

Structure: Apparently the interorbital distance is narrower in *S. h. albus* than in *S. h. holbrookii*, being in body length 9.3-10 in *S. h. albus* and 6.77-8.5 in *S. h. holbrookii*.

Note: We have seen live specimens from Gainesville, Florida, which seemed almost as light as the preserved specimens of this subspecies.

Hurter's Solitary Spadefoot.

Scaphiopus holbrookii hurterii (Strecker).

Range: Eastern half of Texas. Records exist from Houston and Edna to Cameron County.

Habitat: Like other spadefoots, they come out of their burrows to breed in temporary pools.

Size: Medium. Type 67 mm. from Waco. Refugio specimen 63 mm. The range of size of ten breeding adults from Lytle, Texas, (collected by A. J. Kirn, June 28, 1931) is 66–78 mm. Adults, 1 3/4–3 1/8 inches. (Males, 73 mm. Females, 44–78 mm.).

General appearance: "Head short, length about equal to width. (In *holbrookii* the head at angle of mouth is much wider than long). Snout heavy and blunt, not extending beyond the mouth. Parotoids nearly round, higher and even more conspicuous than in the eastern species. Tympanum distinct but rather smaller than in *holbrookii*. (In type hardly more than half the diameter of the parotoid). Crown distinctly rugose. No black granules in space between and in front of the eyes. Upper surfaces with small, closely set tubercles, very uniform in size and distribution. Many tubercles on sides, buttocks, and posterior portion of the abdomen.

"Color above, pale greenish, with a pale yellowish line from each orbit; these converge again in the coccyx. Upper surface of head and area between the light lines, dark plumbeous, parotoids olive. Sides of head and under surfaces yellowish-white." (Strecker, 1910, p. 116–117).

Structure: "Many pustules on upper surface of tibia. Glands on thorax present, conspicuous. Enlargements resembling glands on inferior surface of femur (present in both specimens). Spade-like process of foot narrowly margined with black. Palmar tubercles rather small. Fingers slender. Tibia about equal to that of *S. holbrookii* but femur and foot much shorter." (Strecker, 1910, p. 117).

Distinguished from *S. holbrookii* by "its more compact form, narrow head, blunt muzzle, unusually high parotoids, smaller palmar tubercles and shorter hind limbs. The sides, buttocks, tibia and posterior portion of the abdomen are covered with tubercles instead of being almost perfectly smooth. The tubercles on the upper surfaces are more uniform in size." (Strecker, 1910, p. 116).

Mr. Kirn's (June 28–29, 1931) material when compared with male *S. holbrookii* of the same size, has smaller measurements. The head to angle of mouth, the width of head, the tympanum (equal in one), the snout (greater in one) were less than in *S. holbrookii*. The hind limbs were equal in the two species. This subspecies is still a debatable form.

Breeding: April 13, 1910. June 1904 (Strecker). See *Notes*.

Notes: On February 9, 1932, Mr. A. J. Kirn of Somerset, Texas, sent us ten preserved *Scaphiopus* which Mr. Strecker pronounces *S. hurterii*. On February 15, 1932, he writes, "They (the spadefoots) are not calling as yet. I found one of them last year, January 27,—in the road, during a rainy spell. I will send you some of the *Scaphiopus* when they come out to lay. Do not know when this will be." His field notes for these ten spadefoots are somewhat as follows: "Lytle (Somerset, Texas) June 29 (Monday) 1931. Rain Friday 8 p. m. through most of Saturday and again yesterday, early morning and late evening, again early this morning and this afternoon, about three inches altogether. Weather warm. *Scaphiopus hurterii*? heard last night at all pools at wells (old slush pits). Collected a dozen at No. 10 and No. 13 (4 pairs in copulation. In all of these, the smaller and lighter one was male). Collected between 10 and 11 p. m. June 28. This afternoon, I found eggs already hatched at nos. 10 and 13 wells. No spadefoots heard before 8.30 p. m. yesterday. Eggs evidently laid last night after midnight. Were hatched at 7 p. m. today and how long before I do not know. The spadefoots collected last night varied from gray and yellowish green to dark, all with two dorsal stripes (widening on middle posterior back). Parotoid glands distinct in all. Had in can all of today. Many eggs laid in the can. Not any spadefoots heard or found tonight, June 29."

Giant Toad. Colorado River Toad. Girard's Toad. Colorado Toad.

PLATE IX. 1, 2, 3, 4. Females ($\times \frac{1}{3}$).

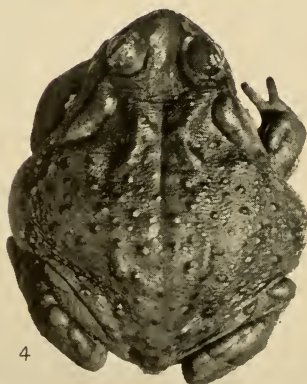
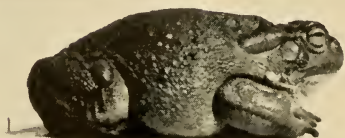
Bufo alvarius Girard.

Range: Southern Arizona and southern California into Mexico.

Habitat: Semi-aquatic. General locality of large permanent streams or the irrigated portions of our southwestern desert regions.

Size: Adults, $3 \frac{1}{4}$ – $6 \frac{3}{5}$ inches. (Males, 80–156 mm. Females, 87–165 mm.).

General appearance: This is a very large grayish or brownish green toad with smooth leathery skin and a few scattered small rounded warts. The under parts are light. The head is broad and flat, marked by low broad crescent shaped crests curving around the rear of the eye. These are like fleshy folds. The canthus rostralis is marked by a ridge which turns down in front of the eye as a preorbital. One to four white warts are present back of the angle of the mouth. The parotoids are large, subreniform in shape spreading downward at the shoulder. There is a large glandular wart on the femur and a long one or several shorter ones on the tibia. These glands are the conspicuous mark of this toad and appear early, being present in a $1 \frac{3}{4}$ inches (44 mm.) individual.



Structure: One to four white warts back of angle of mouth; parotoids large, subreniform, spreading downward on shoulder; large glandular wart on femur and a long one or several shorter ones on tibia; two metatarsal tubercles; two large palmar tubercles; first finger about equal to second; first finger of female may look very long and slender, that of male much heavier at base; palms and soles tuberculate; interorbital much wider than internasal space; a membranous fold at the inner edge of the tarsus; horny excrescences on fingers of male may be very prominent, starting from back of wrist and extending all along inner side of first finger and covering upper surface as well; second finger has upper surface with excrescence as well as triangular patch from tip backward; slight on third; tympanum may be obliquely vertical and elliptical or almost round and very little oblique.

Voice: There is no good description on record. Miss Dickerson called it a "gentle chirping," and Ruthven quoting J. J. Thornber wrote, "I assure you there was no lack of noise that day or night, the croaking being incessant."

Breeding: The probable time is May to July when the summer showers arrive. Sabino Canon, June 1903, "A small stream of water came down from the mountains as a result of rain above, and these toads appeared in abundance, pairing almost immediately. On that day every female was laying eggs. The eggs were laid in the clear stream of water, which was perhaps a foot to eighteen inches deep." (Ruthven quoting J. J. Thornber, 1907, p. 506).

Notes: "Nothing was seen or heard of them until the advent of the early summer rains which formed a large shallow lake near Buenos Ayres, Arizona. These large toads then filled the air with their loud cries, which increased until a deafening roar was produced. Numbers of them were seen hopping about, but their rarity was not suspected. . . .

"San Bernadino Springs. July 6, 1892. . . . Lieutenants Gaillard and Irwin and the writer lay down to rest upon the damp grass beside the San Bernadino Springs. . . . At dusk these huge green batrachians began to hop about us, occasionally landing upon our faces." (Mearns, 1907, p. 113).

July 30, 1917. Just southeast of Tempe, Arizona. In a water hole near a culvert Ralph Wheeler and I caught six immense toads. All males. Probably tardy ones. The tadpoles in the hole are probably of this species.

We have never seen any Colorado River toad cover itself with secretion as protection from dogs or other animals which might prey upon it, but authentic instances are recorded of death to dogs from seizing them. These toads appear to us Easterners as huge, and several of my campmates at White Sulphur Springs, W. Va., will never forget seeing one of my escaped Colorado River toads hopping through the campfire circle.

American Toad. Northern Toad. Hop Toad.



PLATE X. 1, 2, 3, 7. Males ($\times \frac{1}{2}$). 4. Male trilling, while sitting in shallow water ($\times \frac{1}{3}$). 5. Young ($\times \frac{1}{2}$). 6. Coils of egg strings on the bottom of a pond ($\times \frac{1}{4}$).

Bufo americanus americanus Holbrook.

Range: Eastern North America from Hudson Bay southward. A Transition and Canadian zone form. Common throughout its range.

Habitat: Common in gardens and cultivated fields, appearing more by night than day. During the sunshiny hours they seek cover beneath piazzas, under board walks, flat stones, boards, logs, wood piles or other cover. When cold weather comes, the toad digs backwards into its summer quarters or may choose another site for its hibernation.

Size: Adults, 2 $\frac{1}{6}$ –4 $\frac{1}{4}$ inches. (Males, 54–85 mm. Females, 56–110 mm.).

General appearance: Short and fat in body, it has a short broad head and the snout broadly circular. The lower surfaces are roughly granular, the back covered with various sized warts, some of which are large ones in pairs down the middle of the back. There are three or four pairs of dark spots down the back, each with one large wart. The eyes are prominent. The arms

and legs, hands and feet, are warty or roughly tubercular. There are dark spots on the arms and legs, along the sides, and a few on the belly. Some males have yellow throats and considerable yellow on the under side of the base of the legs and in the groin. The general color is olive, with parotoids and crests brown.

Structure: Parotoids large and oblong, connected to the post-orbital crest by a longitudinal ridge. Crests on the head form a right angle at the corner of the eye, one branch extending downward in front of the ear; males with dark throats; males with excrescences on inner-upper side of first two fingers and on inner carpal tubercle; many spiny warts particularly on the hind legs.

Voice: The call is a long sustained, musical, high pitched trill.

Breeding: They breed from April 5 to July 25, the crest about April 30. The eggs are in long spiral tubes of jelly, each egg $1/25$ – $1/16$ inch (1–1.4 mm.) in diameter; the inner tube $3/5$ – $1/12$ inch (1.6–2.2 mm.), the outer tube $1/8$ – $1/6$ inch (3.4–4 mm.). The eggs, 4,000–8,000 in number, are laid in two strings, and hatch in 3–12 days. The small, dark, almost black tadpole $1\ 1/12$ inches (27 mm.) has an ovoid body broader near the vent than at the eyes. The dorsal crest is low, extending slightly onto the body, the tail short, its tip rounded. The tooth ridges are $2/3$. After a tadpole period of 50 to 65 days, they transform June 1 to August at $1/4$ – $1/2$ inch (7–12 mm.).

Notes: "While the farmer sleeps the toad is searching his lawn and garden and cornfield for insects and their relatives. He feeds upon nothing else. Cutworms, ants, potato bugs and chinch bugs are delicacies to him, and he snaps them up steadily with his loose flap of a tongue until his sides stick out and he can hold no more." (H. Garman, 1901, pp. 60–61).

Hudson Bay American Toad.

Bufo americanus copei Yarrow & Henshaw.

Range: Hudson Bay, James Bay. In August 1932, Mr. Calvin Goodrich collected a series at Moose Factory for Dr. H. T. Gaige. She like Drs. Stejneger and Barbour feels that this form should be brought out from the synonymy of *Bufo americanus*.

Size: The extremes of Mrs. Gaige's and Mr. Kennerly's series are 69 mm. and 75 mm. or $2\ 3/4$ –3 inches.

General appearance: Some of its outstanding characters as contrasted with the American toad are its bright coloration, long narrow parotoid glands, and greater width between the cranial crests. A broad median yellowish-white stripe runs down the back.

Structure: Parotoids twice as long as broad, situated well back on the shoulders; hind-limbs longer than the body length; cranial crests well developed.

Northwestern Toad. Baird's Toad. Mountain

Toad. Columbian Toad.
Small-spined Toad.
Northern Toad. West-
ern Toad.

PLATE XI. 1, 2. Males ($\times \frac{1}{2}$). 3. Hindfoot of male ($\times \frac{2}{3}$). 4, 5. Females ($\times \frac{1}{3}$).

Bufo boreas boreas (Baird and Girard).

Range: Colorado, north and west to Puget Sound, British Columbia and south-western Alaska.

Habitat: General vicinity of larger streams. Floor valleys, mountain meadows and canyons to high elevations. To the coast in Washington and Oregon.

Size: Adults, 2 $\frac{1}{4}$ –5 inches. (Males, 56–108 mm. Females, 60–125 mm.).

General appearance: This large brown, gray or green toad has a broad light streak down the speckled back and a light patch under the eye. The under parts are commonly speckled or marbled with dark. The skin is very warty with large round warts. The fingers and toes have dark tips.

Structure: No cranial crests; rounded gland in middle of tibia; body flat, broad, head narrow and pointed in proportion; no discolored throat in male; spread of hind foot usually more than 36 per cent of total body length.

Voice: See Notes.



Breeding: They breed from June to July. The eggs are doubtless in strings like those of *B. boreas halophilus* of California. The tadpoles are small 1 1/12 inches (27 mm.). There is no description of them on record. After a tadpole period of 30 to 45 days, they transform from July to September at 3/8-1/2 inch (9.5-12 mm.).

Notes: British Columbia. "Warts on back show a tendency to run in longitudinal rows. Tibia with one large and one small parotoid-like wart located respectively in the central and the rear cross bars." (Patch, 1922, p. 77).

British Columbia. "On the nights of June 11 and 12, 1928, these toads were seen in numbers in a large pond on the beach at Kaslo. The males were calling and greatly outnumbered the females; nearly all the specimens collected or examined at the pond were males. One male was seen on the beach in embrace with a dead female which was much dried and shrivelled. . . .

"A female of 108 mm. taken at Kaslo on June 11, 1928, had apparently finished spawning; two other specimens of 81 and 101 mm. taken at Summerland in July, one on the 17th, were full of eggs. A specimen of 93 mm. taken at Lytton between the 1st and 8th of July, 1925, had evidently spawned.

"On the night of June 12, strings of eggs were found strewn among the grasses in the pond in water six or eight inches deep. The water temperature was 66°F." (Logier, 1932, p. 321).

California Toad. Salt-marsh Frog. Baird's

Toad. Common Toad.

PLATE XII. ($\times \frac{1}{2}$). 1. Male.
2, 3. Females.

Bufo boreas halophilus
(Baird and Girard).

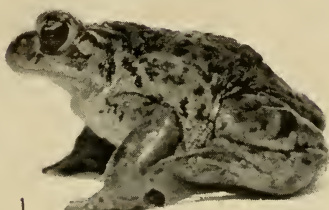
Range: Western Nevada,
central and southern coastal
California and northern
Lower California.

Habitat: Open valleys,
rarely wooded areas. In high
mountains, found in wet
meadows and along lake
shores.

Size: Adults, 2 $\frac{2}{5}$ –4 $\frac{5}{8}$
inches. (Males, 62–101 mm.
Females, 60–116 mm.).

General appearance: This is
a large stocky toad with short
limbs, green or greenish
brown with a light streak
down the back, and the back
mottled with irregular dark
areas which surround the
warts singly or in irregular
groups. The warts are
rounded and the skin be-
tween the warts quite
smooth. The white or yel-
lowish under parts are in
some individuals blotched
with black.

Structure: No cranial crests
(except occasionally in very
large individuals); parotoids
elongate, widely separated;
two large metatarsal tuber-
cles, inner with a free blunt
end; spread of hind foot usu-
ally less than 36 per cent of
head and body length; glands
on tibia present; no external



1



2



3

vocal sac apparent in the males; interorbital space only slightly greater than internasal space; first and second fingers equal; not as heavily pigmented as *B. boreas boreas*.

Voice: Its song is a slow deep-toned prolonged trill. "The droning call of *B. woodhousii* is hard to tell from that of *B. fowleri*, at least when one hears them apart, as he must in the field. On the other hand, *B. americanus* and *B. californicus* are much alike and the rattling call of *B. cognatus* very different. *B. halophilus*, on the other hand, has no call to speak of. It is the quietest *Bufo* I know." (Letter of G. S. Myers, April 9, 1933).

Breeding: They breed from January to July, according to the climate of location. The eggs are in long strings laid at the margins of ponds or at edges of flowing streams and are occasionally in two or three rows. There are no partitions between the eggs. The vitellus is $\frac{1}{16}$ inch (1.7 mm.), the outer tube $\frac{1}{5}$ inch (5 mm.), the inner tube $\frac{1}{7}$ inch (3.6 mm.). The dull blackish medium tadpoles are $2\frac{1}{5}$ inches (55 mm.). The tooth ridges are $\frac{2}{3}$. After a tadpole period of 28 to 45 days, they transform from April to August at $\frac{1}{2}$ inch (12 mm.).

Notes: "The California toad is such a heavy-bodied animal that it seldom hops in the conventional manner. . . . When not frightened it walks in slow fashion dragging the hind feet so that toes are continually in contact with the ground." (Grinnell and Storer, 1924, p. 636).

Arroyo Toad. Southern California Toad.

PLATE XIII. ($\times \frac{2}{3}$). 1, 2. Males. 3, 4. Young. 5. Female.

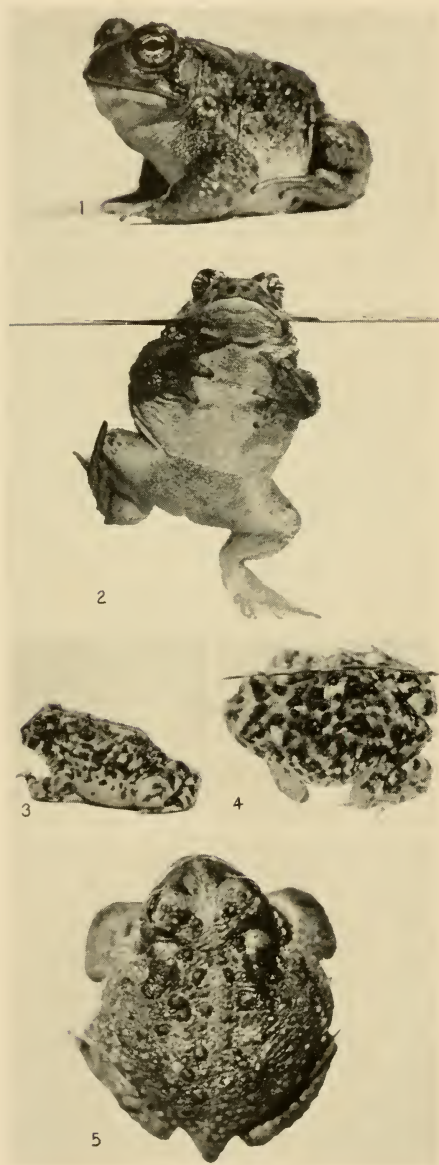
Bufo californicus (Camp).

Range: Coastal region of southern California (Ventura Co., Los Angeles Co., San Diego Co.) into Lower California. Across divide into San Bernardino County. The early records were confined almost entirely to the foothills of the western slope.

Habitat: "Moderately common in inland valleys and foothills."—(L. M. Klauber, 1928, p. 2). "In San Diego County the range seems largely restricted to the sandy washes of the rivers in the Upper Sonoran Zone."—(Klauber, 1931, p. 141).

Size: Adults, 1 $\frac{5}{8}$ –2 $\frac{3}{4}$ inches (42–68 mm.).

General appearance: This is like a small Great Plains Toad (*Bufo cognatus*), but is more uniform in color on the back, lacking the conspicuous dark spots and light streaks and vertebral streak of that form. The limbs are barred or spotted with black. This little toad is very short and thick in body, very short in head, and the arms and legs appear very stolid. The foot is a little longer than in *B. cognatus*. The eyelids and parotoids are tuberculate. Several of the larger warts have spiny tips, in some



cases several tips to one wart. There is an oblique black bar on either eyelid ahead of which is a prominent light band across the top of the head. Their backs are greenish gray with several dark tuberculate spots and in a toad that has recently shed its skin, there is a row of conspicuous light tubercles on the side, bordered above and below by irregular black lines. The venter is a clear bluish white in strong contrast to the back. In the young, the light and dark areas of the head and back are strongly contrasted.

Structure: Parotoids wider and longer (width in length 1.75-2) than in *B. cognatus* (width in length 1.5-1.8); parotoids broadly oval, divergent; parotoid interval wide, twice the width of one gland; snout vertical in profile; cranial crests lacking, occasionally a postorbital bar being present and the posterior end of the cranial valley slightly suggesting embossment. In young specimens there may be a slight indication of cranial crests approximating in front, as in *B. cognatus*; much smaller than *Bufo cognatus*; one cutting metatarsal tubercle and one small one; femur short; foot about one-half webbed; hind legs long; half or more of femur free from body skin.

Voice: Its call is a sweet trill.

Breeding: "The end of May and the first part of June appear to be the breeding season of *californicus*." (G. S. Myers, 1930, p. 77).

Notes: "In San Diego next day we visited Mr. Klauber and he had a number of live adults of *californicus* obtained at Rincon, San Diego County, a few days previously. He says they are easily caught on sandy or gravelly stretches in the bottoms of washes along the streams. If one stands still in the dark in early evening in such localities, particularly in the vicinity of growths of oak, the toads finally begin to move about and can then be found by quick use of the flashlight in the direction of the rustle of the dead leaves." (G. S. Myers, 1930, p. 76).

March 25, 1930. Our experiences with these toads in life have been entirely with material sent us by Mr. L. M. Klauber. At present we have four, two males and two females in our toad garden. During the day they keep themselves buried in the moist soil with just their heads out. They are not always sleeping, however, as they promptly stir if an ant is thrown near them. Toward evening they are more active and hop around. One toad seems to have adopted an evening perch in a pot of Herb Robert. During the evenings, the males sometimes give brief calls, just enough to suggest their little trill.

Yosemite Toad. Yosemite Park Toad.

PLATE XIV. ($\times \frac{2}{3}$). 1, 2, 5. Males. 3, 4. Females.

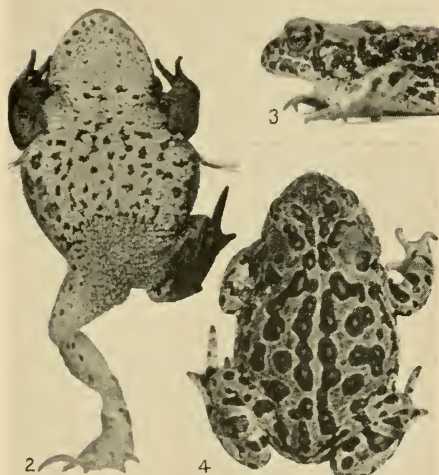
Bufo canorus Camp.

Range: Yosemite National Park, high central Sierra Nevada, 7,000–11,000 feet altitude.

Habitat: Wet mountain meadows, margins of streams and lakes.

Size: Adults, 2–3 inches. (Males, 50–64 mm. Females, 57–75 mm.).

General appearance: This small toad has a moist skin. The male is an almost uniform yellowish olive to olivaceous black with a broken thread of yellow down the mid-back. The black dotted borders of the darker markings and dark areas around the warts are evident to greater or less degree as the toad is lighter or darker in color. These may be outlined by broken threads of yellow, a delicate tracery. Along the sides may be a yellowish band. The parotoids may be marked with russet. In the female, the general background color is a light greenish gray marked with many inky black areas. This background may vary from a pale ash gray to dark brown. When the female is dark, she does not look so unlike the male. The snout, top of head, arms and legs are distinctly spotted. The sides



are marked with a few large black areas. There is a narrow light streak down mid-back, with a black band or irregular black areas on either side oftentimes breaking the midline. At the rear of the jaw is a large russet tubercle and along the sides and on the arms are a few small ones of similar color. Beneath, the toad is a bluish white, sometimes speckled with black.

This toad has no crests on the head but has a distinct rounded ridge from the nostril over the outer edge of the eyelid. This gives the canthal region a distinct border above and with the steep snout gives the toad a square-snouted appearance. The head is not as short, however, as in *Bufo cognatus*. The nostrils are widely separated. In general shape, the toad reminds us of *Bufo boreas halophilus*. Its color is intermediate between that form and the heavy inky blotches and contrasting light areas of *Bufo cognatus*.

Structure: Short, broad, raised parotoids close together; parotoid interval less than the width of one gland; pattern of back extending across parotoids making them less conspicuous, particularly in female; muzzle rounded; cranial crests lacking or slight in some males; legs short; gland on hind leg; interorbital space narrow; internasal space wide; warts few, low, flattened and rounded; foot with two metatarsal tubercles; tympanum small; skin smooth and moist like that of a *Rana*.

Voice: The song is a sustained, rapid, melodious trill.

Breeding: They breed during late spring and summer, May 20 to July 16. See *Notes*.

Notes: "The Yosemite Toad undoubtedly hibernates for a considerable period. . . . The hardihood of the species is indicated by the way in which the adults jubilate in the melting snow water during the spring and early summer months." (Grinnell and Storer, 1924, p. 658).

Three young specimens in the University of Michigan collection were examined. They were taken at Tuolumme Meadows, August 31, 1922. They measured 15, 16, and 16.5 mm. They showed a faint white vertebral stripe; dark spot on inner half of each eyelid; spots along vertebral line black, brown centered, and forward, sometimes encircled with whitish from vertebral line; quite spotted in pectoral region.

"June 5, 1930. Peregoy meadows. Saw at least two dozen old and young. Majority were young. They were not so abundant as the croaking tree frogs, *Hyla regilla*. Hadn't distinguished sexual dimorphism until I found a mated pair in a very wet grassy meadow, water three or four inches deep when one steps in it. These meadows are surrounded by snow fields. Found no toad eggs. Toads must have just come out." (C. E. Van Deman).

Great Plains Toad. Say's Toad. Western

Toad. Plains Toad.
Texas Toad. Western
Plains Toad.

PLATE XV. ($\times \frac{5}{8}$). 1, 4. Females.
2, 3. Males.

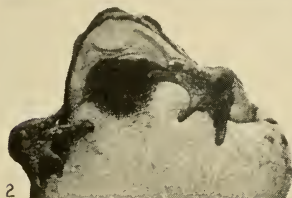
Bufo cognatus (Say).

Range: North Dakota and eastern Montana, southwest across Colorado, Wyoming, Kansas, Utah, the Panhandle of Texas into Mexico and west into eastern California.

Habitat: Grazing lands or agricultural lands of the Great Plains, along irrigating ditches, flood plains of streams and overflow bottom lands.

Size: Adults, 1 $\frac{7}{8}$ –4 inches. (Males, 47–95 mm. Females, 60–99 mm.).

General appearance: This is a large broad-bodied toad with a general color of brown, gray or greenish. There is a light mid-dorsal stripe and the back is marked with dark spots. These spots may be broken up and the light areas or borders become more conspicuous so that the toad appears obliquely streaked with light bars on the sides. The spotted condition seems the more common. Often there are four pairs of bright green spots down the back, the pair at the rump leading diagonally to the groin. There are green spots on the legs, and an oblique row of green spots extending backward from the sharply raised pa-



rotoid. There is a green band along the side. These green spots are partially outlined with black on the green and cream on the outer edges. The under parts are light, including the throat. In these males, the light throat extends back as a flap over the thin, dark colored skin of the lower throat which extends forward when inflated. In another toad, the green spots are more broken up, and the green band on the side becomes broken into spots. The head is broad, the snout short. The sides and front of the snout are steep. The hands and feet are light with dark tips. The conspicuous mark of this form is the large boss covering the prefrontal region from the anterior $1/3$ of the orbit to the nostril. Extending backward from this are the two broad superciliary ridges forming an open angle.

Structure: Head broad; snout short; sides and front of snout steep; boss conspicuous, ridges divaricating at rear; parotoid glands small, elevated, widely separated, oval in shape extending obliquely downward; two metatarsal tubercles with free cutting dark edge; hind leg approximates body length; hind foot long in proportion to hind leg; interorbital space narrow; internasal space greater than interorbital; snout only equal to or less than eye; toes webbed, webs deeply indented; nostrils set far apart; femur short; horny excrescences on back of first finger of male, and to less degree or lacking on the second finger.

Voice: The vocal sac of the male is a large "sausage" extending out and upward. Deflated, the thin discolored skin is closely folded under an apron-like extension of light colored pebbly skin of the throat. It is at the rear of the throat and the 'apron' may hang down over the forebreast as much as 15 mm. The call is made up of harsh low pitched notes, "harsh, chattering call." (Klauber).

Breeding: They breed from April to September, dependent upon rainfall; in the northern states of their range, from May to July. Little is known about the eggs and tadpoles.

Notes: July 8, 1917. We found a large stream rushing through Sierra Blanca, Texas. They had not had rain for six months. The flat land was overflowed and a swift current went under the small bridge. At seven o'clock, while it was still day, we heard no notes in the creek, but later when we were camped one half mile away, we heard the chorus plainly and decided it must be spadefoots. . . . We found three species of toads and two of spadefoots migrating from the mountain sides of Sierra Blanca downward toward the pool and noise. The boys, at night, captured *B. woodhousii*, *B. cognatus* and *B. compactilis* on the hillside and in the stream.

The Spade-footed Toad. Spadefoot Toad.

Sonoran Toad. Western Toad.

PLATE XVI. 1, 2, 5. Males ($\times \frac{2}{3}$). 3. Male croaking ($\times \frac{1}{2}$). 4. Egg files ($\times \frac{1}{2}$).

Bufo compactilis Wiegmann.

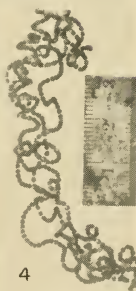
Range: Southern portions of Utah and Nevada south far into Mexico, and east to Oklahoma and the eastern timber belt of Texas.

Habitat: We found this toad breeding in rain pools in open fields near streams, in pools in creek valleys, in irrigation tanks or cattle tanks. It is a desert form that may at times be seen feeding at night under the street lights of desert towns.

Size: Adults, 2 $\frac{1}{12}$ –3 $\frac{5}{8}$ inches. (Males, 52–78 mm. Females, 54–91 mm.).

General appearance: This broad, "squatty" toad of medium size is pinkish drab in color, marked with dull citrine spots. The fingers and toes are light in color. The under parts are light. The back is covered with light tipped tubercles. In the male, the tip of the chin is white, then the folded part of the throat is pinkish buff with ecru-olive in the center. This area is followed by a circular pectoral area of purplish lilac.

Structure: Parotoid, elongate, sometimes smooth; no sharp-edged ridge from eye to



nostril, nostril area smooth; crown without bony ridges; snout short, blunt; interorbital space about equal to upper eyelid; first finger at least equal to second; toes half webbed; sole tubercles large, each with a cutting edge; tympanum much smaller than the eye.

Voice: The vocal sac is a large fat oblong "sausage." Deflated it forms a light apron covering several darker folds in the rear of the throat. The call is loud and shrill, a trill.

Breeding: They breed from May 1 to July 10, or a few stragglers later, with the late summer rains. The brown and yellow eggs are in long fine coils, the jelly tube narrow, $1/12$ inch (2 mm.), the eggs crowded, 14-20 eggs in $1\ 1/5$ inches (30 mm.), the vitelli $1/16$ inch (1.4 mm.). They hatch in 2 days. The bicolored tadpole is small, $1-1\ 1/8$ inches (24-28 mm.), light colored, its back a drab or light grayish olive; its belly, pale cinnamon pink; its tail crests translucent. The tooth ridges are $2/3$. After a tadpole period of 40 to 60 days, they transform, June 1 to August 1, at $1/2$ inch (12 mm.).

Notes: May 11, 1925. San Antonio, Texas. The next place we stopped was Leon Valley Creek. Here was a big chorus of *B. valliceps*, *B. debilis*, *B. compactilis*, and *S. couchii* in considerable numbers. . . . *B. compactilis* males were calling from the bank. Each one often seemed to have a favorite perch, and when scared away from it by our light sometimes would return almost immediately. Their call is loud and shrill, and a big chorus would be deafening. Their throats swell out in sausage form like *B. quercicus*, only shorter and fatter in proportion to their large size.

May 29, 1925. Comfort, Texas. . . . At the far end of the cultivated field, the pond extended into a more grassy pasture. Here the *B. compactilis* were calling in considerable numbers. A few had standings on the shore, several were out in clumps of grass. They are well called the spadefoot toad. They are usually the associate of the spadefoot (*S. couchii*). A few were calling when we first reached the spadefoot pond. Their call is very shrill. . . . In the pond were many oats half-grown and more with oats on the stems. Beside an oat stem a male would rest in the water in vertical fashion, sausage-like throat extended $1\ 1/2-2$ inches, directed outward and upward above his head much like *B. quercicus*.

June 16, 1925. We left Rio Grande City, Texas, 7:45 a. m. and stopped at Santa Cruz ranch, opposite a hill with U. S. Geo. Survey marker. At the top of the hill we could clearly hear *B. compactilis* in a pond across the road. These males which are croaking in the daytime are in the dense shade of overhanging trees.

Little Green Toad. Sonoran Toad. Green Toad. Sonora Toad.



PLATE XVII. 1. Female ($\times 1$). 2. Male croaking ($\times \frac{2}{3}$). 3. Male ($\times \frac{2}{3}$). 4, 5. Females ($\times \frac{3}{4}$). 6. Female ($\times 1$).

Bufo debilis Girard.

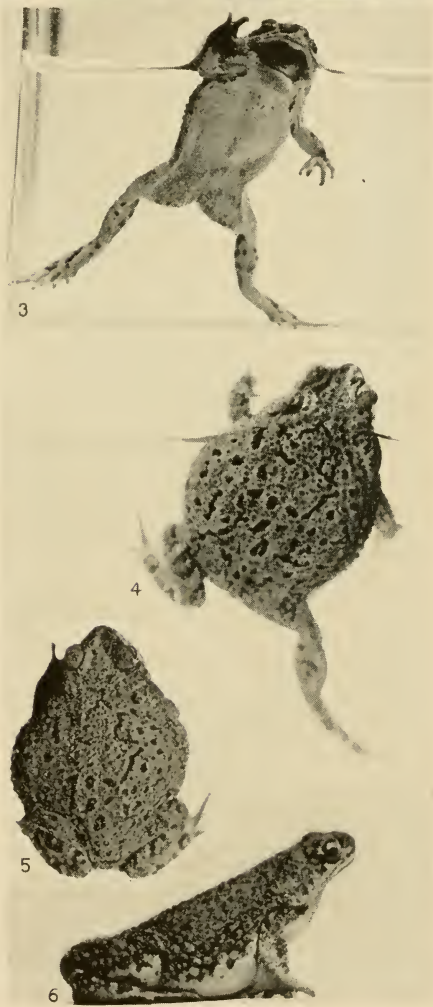
Range: Colorado and Kansas south through New Mexico and Texas into northern half of Mexico.

Habitat: They are found on grassy mesquite flats, breeding in temporary rain pools, ditches or shallow pools in streams of intermittent flow.

Size: Adults, 1-1 $\frac{4}{5}$ inches. (Males, 26-41 mm. Females, 31.5-46 mm.).

General appearance: This beautiful little green toad has black spots on the back and some gold or yellow tipped tubercles on the sides and legs. The legs have a few dark bar-like spots with light central areas. The legs are short, the snout pointed, the parotoids large and elongate or triangular, the body narrow and rounded in contour, the head narrow with interorbital space proportionally wide. There is a black bar at the arm insertion and there may be a black line, or two or three spots in the middle of the lower breast.

Structure: Crown without bony ridges; snout protruding; first finger shorter than second; hind legs usually shorter than body length;



tympanum small; toes slightly webbed at base; foot short; no tarsal fold; parotoids sometimes extending downward to the level of the jaw.

Voice: The vocal pouch is a round ball reaching to the tip of the chin. Deflated it is a pectoral flap like *B. quercicus*. The call is cricket-like, a low sustained trill.

Breeding: They breed from the last of March to mid-June. "The eggs are in small strings and are attached to grass and weed stems. . . . The tadpoles are slightly smaller than those of *B. punctatus*." (Strecker, 1926, p. 10). They transform at 1/3-2/5 inch (8-11 mm.).

Notes: March 28, 1925. Between San Diego and Alice, Texas, at 8:15 we heard in a roadside ditch our customary *Pseudacris*. There was a strong breeze blowing along these ditches, but we heard a note absolutely new to us—something like a cricket. At first I thought it might possibly be *Hypopachus cuneus* for which I went to San Diego. The instant we came to the pond and they appeared light colored under the flashlight, I knew it must be *Bufo debilis*. It is rightly named "the little green toad." In some ways, its note makes me think of Fowler's toad, but is not nearly so loud or strong. The call is sustained. When I first went down to the pond, I thought I heard only one, but before I got the light on it to see how it croaked, two of them started hopping toward the ditch. They were out of the water, and are very shy forms. Their throat pouch would suggest *B. quercicus*. In some ways, the toad and its note remind me of *B. quercicus*, but *B. quercicus* is much louder and shriller. A cricket was calling nearby, and the *B. debilis* note is something like it. We thought they had sharp noses reminding us of the narrow-mouthed toad.

When held in hand the male gives a little bat-like click, like marbles hitting together. Over in the mesquite, "devil's elbow" and prickly pear, we went for two or three we heard, and came back with one of them. There was a small ditch or runway there.

By a railroad and creek bridge we heard two or three *B. debilis*, and caught one. *Pseudacris* in great chorus at 9:45 also *B. valliceps*, and a few *Gastrophryne*. In a shallow overflowed mesquite area, quite a few *B. debilis* males were calling. Often times when you approach, or particularly when you put light on them, they duck flat to the ground. The throat vesicle when inflated is a round ball reaching to the tip of the chin, quite in opposition to what we expected because of the pectoral flap when not inflated. . . .

March 29. Beeville, Texas. *Bufo debilis* note at times is something like the "clucking" one gives to make a horse travel faster.

Fowler's Toad. Danver's Toad.

PLATE XVIII. 1, 4, 5. Males ($\times \frac{2}{3}$). 2. Adult ($\times \frac{1}{3}$). 3. Female ($\times \frac{2}{3}$).

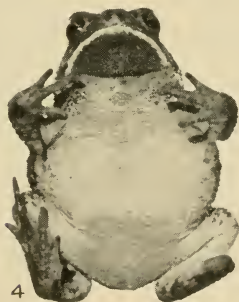
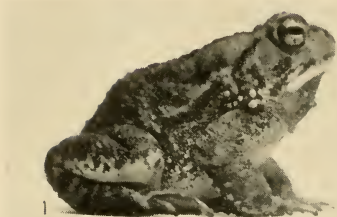
Bufo fowleri Hinckley.

Range: New England and New York south to Georgia, west along the Great Lakes to Michigan and along the Gulf Coast to Central Texas. It is an Upper Austral species.

Habitat: Beaches, coasts, lake shores, or river banks, which are the more sandy and warmer places throughout its range, are the usual choice. It is common along roadsides, about homes, in fields, pastures and gardens, sand dunes and pine barrens. It breeds in the shallow water of permanent ponds or in flooded low ground or roadside ditches, or along river shores.

Size: Adults, 2-3 $\frac{1}{4}$ inches. (Males, 51-74.5 mm. Females, 56-82 mm.).

General appearance: These toads commonly have a greenish cast to the general color with a yellowish or buff mid-dorsal stripe. The back is marked by distinct black-edged dark spots. The tubercles are reddish brown, and usually several small ones occur in each of the dark spots. The parotoids are long ovals. The under parts are cream-colored with a dark pectoral spot. The throat of the male is black, that of the



female like the rest of the under parts. When inflated, the black of the throat is thickly dotted with white round flecks. In a pair, the male *Bufo fowleri* is usually darker than the female. Of live toads sent us from Virginia, we wrote: These are small toads with low crests. One is dull greenish in color, one reddish brown, each with a light mid-dorsal line. The warts are small, rounded and generally uniform in size. There are several warts grouped in each dark spot of the dorsal pattern. The parotoids are elliptic and nearest together at their mid-points. The ventral surfaces are buffy. The throats of the males are greenish black. One toad has the black pectoral spot, another one lacks it. Both toads have dark bands along the sides. One has considerable yellow in groin, on rear of the femur, and on tibia and tarsus.

Structure: Crests variable, at times forming a boss; adults never reaching the greater size of *B. americanus*; warts on back small and uniform; no preparotoid ridge from parotoid to postorbital.

Voice: The song is a screech or wail, a striking nasal *whir-r-r-r*. H. A. Allard described it as "a brief penetrating droning scream."

Breeding: They breed from April 15 or earlier to mid-August. In a given locality, this form breeds later than the American toad. The eggs are in long files, crowded at first in a double row, and numbering as many as 8,000. The egg is $1/25$ – $1/16$ inch (1–1.4 mm.), the outer tube $1/10$ – $3/16$ inch (2.6–4.6 mm.), the inner tube absent. The tadpole is small, $1\ 1/12$ inches (27 mm.), its greatest width toward the rear of the body. The tail crests are low, the tooth ridges $2/3$. After a tadpole period of 40 to 60 days, they transform from mid-June to August or later at $5/16$ – $1/2$ inch (7.5–11.5 mm.).

Notes: June 1, 1917. About six miles beyond Dinwiddie, Va., near the road, we found several files of toad's eggs. In one case the string was a file 8 or 10 ft. long in the current. In another case, in a backwater, the mass was tangled around sticks. In most cases the file contains a double row of eggs. The note we questioned yesterday evening was *Bufo fowleri*. It is quite different from the sweet droning note of *Bufo americanus*.

April 16, 1921. St. Augustine grounds, Raleigh, N. C. In the stream near the edge we found also Fowler's toad eggs wrapped around plants. They were in shallow turbid areas, cattle punched, and in water two to four inches deep. Many were laid last night.

Where the Fowler's toad and American toad are recorded in the same region the latter would more likely occur in the more swampy, higher, colder, and more inland habitats.

Canadian Toad. Winnipeg Toad. Manitoba Toad.

PLATE XIX. 1. Male ($\times \frac{4}{5}$).
2, 4, 5. Males ($\times \frac{3}{5}$). 3. Young
($\times \frac{3}{5}$).

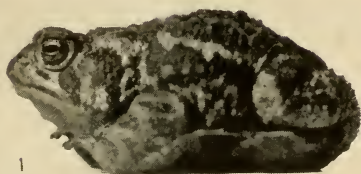
Bufo hemiophrys Cope.

Range: North Dakota, Manitoba. In country tributary to Lake Winnipeg in Canada.

Habitat: Stream valleys, lakes, and Turtle Mountain region.

Size: Adults, 2 $\frac{1}{4}$ –3 $\frac{1}{5}$ inches. (Males, 56–68 mm. Females, 56–80 mm.).

General appearance: These are brownish or greenish toads of medium size and with short snouts. The most marked characteristic is the boss on the head. This is a narrow raised horny structure extending from the rear of the upper eyelids to the snout. Frequently the rear end of this boss forms quite a prominence. It makes one think of a frontal plate of the upper mandible of some rail and coot-like birds. Their backs are covered with many fine rounded warts, generally 2–5 to a dark area. There are many spiny warts on the femur. There is a light stripe down the middle of the back and a conspicuous dark band along the side bordered above by a light line. The under parts are cream or buffy with numerous small black spots, a prominent one in the middle of lower throat. The throat



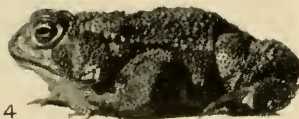
1



2



3



4



5

of the male is dark and extends first in the lower region. It seems to have two secondary swellings at the base of the arms.

Structure: Boss on head from snout to rear of interorbital space; slight furrow down the middle, and outer ridges forming boss are parallel; these ridges connected by a bar at rear and with slight extension toward the eye; broad upper eyelid with closely set tubercles, in sharp contrast with narrow interorbital; snout short, vertical in profile; tympanum elliptical and vertical; two cutting metatarsal tubercles, inner large and spadelike; ventro-basal portion of femur discolored; forethroat of male discolored.

Breeding: They breed from May onward, in shallow edges of lakes or ponds or other water. There are no descriptions of the tadpole on record. They transform at $3/8-1/2$ inch (9-13.5 mm.).

Notes: August 30, 1930. At 11 o'clock we started northward from Grand Forks. At Ardock we found a stream dried up except for isolated pools. Around one in the cow-punched and cracked mud, we took some 7 or 8 young of *Bufo hemiophrys*. They were of two sets of sizes: 36 mm., 33 mm., 26 mm., 23 mm., 22 mm., 18 mm. All of these young specimens have a suggestion of the dark pectoral spot, and only the two larger ones begin to show cranial ridges.

August 31, 1930. It rained in the afternoon. We went through Neche to Walhalla, N. D., at the edge of Pembina mountains. We arrived about 5:30 p. m. It was still raining. We began to get desperate in our desire for live adults of *Bufo hemiophrys*. Before dark, we took an excursion around town looking for possible covers for toads. The evening was cold, the rain had stopped and it was doubtful if toads were abroad feeding. This has been a summer of remarkable drought. We used one of the best expedients of a collector. We engaged a bright-eyed young boy (Audrey Miller) to search the town. Inside of half an hour, he appeared with an adult male. He and another lad started promptly again with a flashlight, and returned twice, each time with an adult toad. We asked where they got them and he said in the gutters, and later he said he got them in the sewers.

Sept. 1, 1930. We went out with the boys, to a place where they had a toad located, but had missed him last night. These males have a throat of the *Bufo americanus* class, but close examination of one which half inflated its throat revealed that the lower throat region expanded first, and there also seemed to be a secondary swelling at ventral base of each arm. The throat seems to have a slight fold across lower throat on the pectoral region. Its boss, this slight indication of a lower throat pouch, and two cutting metatarsal tubercles suggest relationship with *B. cognatus*.

Marine Toad. Giant Toad.

PLATE XX. 1, 2. Male ($\times \frac{1}{3}$). 3, 4. Male ($\times \frac{1}{4}$).

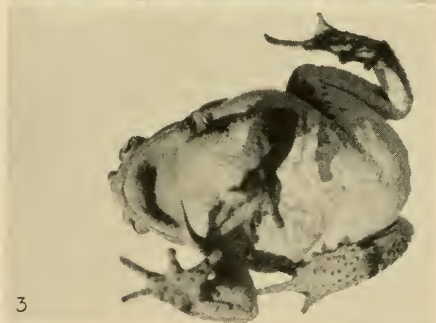
Bufo marinus (Linné).

Range: From Southern Sonora to Tamaulipas in Mexico to Patagonia. Introduced into Porto Rico and Jamaica and several smaller West Indian islands. Found August 20, 1931 by Dr. E. H. Taylor and Mr. J. S. Wright at Zapata, Texas.

Habitat: This toad lives along roadsides, about gardens, or on the edges of swamps and woods. It seeks cover under boards, stones, logs, or in burrows in soft earth.

Size: Many of the larger ones are from $5 \frac{3}{5}$ – $6 \frac{4}{5}$ inches (140–170 mm.), but in South America some reach $8 \frac{4}{5}$ inches (220 mm.).

General appearance: This is an enormous toad with an immense triangular pitted parotoid. The forward side of this triangular gland is just back of the tympanum, the base starts just back of the angle of the jaw and slants slightly upward to meet the very oblique or slanting upper side at a point well back on the side of the body. From this point a row or fold of large blunt rounded brown-tipped warts extends $\frac{2}{3}$ to $\frac{3}{4}$ of the way to the groin. From *Bufo valliceps*, it may be distinguished by its very



large parotoids, larger outer sole (metatarsal) tubercle, its coarser, less even and less pointed tubercles, blunter and lower cranial crests, the usual absence or indistinctness of the parietal ridge, and less distinct color pattern.

Structure: Interorbital region smooth, decidedly concave, shallower in front than behind; crests pronounced—the canthus rostralis is a prominent crest beginning ahead of and above the nostrils and ending at the anterior corner of the eye, where it forks into two ridges, a broad preorbital and a well defined supraciliary crest which curves around the eye, sending off a prominent supratympanic ridge to the parotoid and a very short postorbital; parietal crests absent, indistinct or poorly developed; large broad head, box-snouted; parotoids huge, as long as head or bigger, $4/5-1\ 1/8$ times the head; parotoids widely divergent behind; toes $1/2-2/3$ webbed; free inner metatarsal tubercle; outer metatarsal tubercle large and flat; a thin edged tarsal fold from inner metatarsal tubercle backward; prominent palmar pads at base of first and second fingers; eyelid finely tuberculate; two rows of large fleshy warts down either side of mid-dorsum to vent, more prominent in male. Back of angle of mouth the skin is divided into two or more vertical folds so that at times it might be thought a postrectal gland. However, it is not like the white wart of *Bufo alvarius*.

Voice: Taylor and Wright heard them at Zapata, Texas, but did not describe their call. P. H. Pope in Bermuda holds they have a more resonant and louder call than *Bufo americanus*,—"a deep booming trill."

Breeding: In Bermuda from February to July is the breeding season, April being the optimum month. In Trinidad they breed from August to October, in Demerara, from mid-April to September, possibly also from November to January. The eggs are in strings. Dr. E. L. Mark had some hatch in 68 hours. The black tadpole transforms after 45 days or less. The males have the tops of first two fingers with excrescences, and excrescences on the inner side of third finger and the inner palmar tubercle. Some males have warts and tubercles brown and spiny-tipped.

Notes: Most of the records of food mention beetles and cockroaches. These toads have been introduced into sugar plantations to control insects and one of the recent introductions to be watched with interest is a recent shipment of live giant toads from Porto Rico to Hawaii. It is known that the secretion from the parotoid and possibly from some warts is poisonous to an animal which might seize this toad in its mouth. A dog will die quickly of paralysis after mouthing one of these toads. In the same way, birds, dogs, and other animals, injected with this poison, will die.

Spotted Toad. Belding's Toad. Canyon

Toad. Red-spotted Toad.

PLATE XXI. 1. Male croaking ($\times \frac{3}{5}$). 2, 3, 5. Males ($\times \frac{4}{5}$). 4. Female ($\times \frac{1}{2}$).

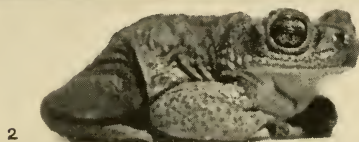
Bufo punctatus Baird and Girard.

Range: South central Texas west to southern California and Lower California.

Habitat: Desert canyons, breeding in rock-bottomed pools of these intermittent streams.

Size: Adults, $1\frac{3}{5}$ –3 inches. (Males, 40–68 mm. Females, 42–64 mm., or even 74 mm. in Lower California).

General appearance: This is a small, delicately formed, alert, attractive toad of grayish, greenish tan, taupe, drab or even red color, with a flattened body and a broad flat back evenly covered with scattered tubercles of small size. The tubercles on the back, sides, and legs may be reddish or orange cinnamon or light vinaceous cinnamon. There may be black rings or partial rings at the bases of the tubercles. The under parts are buff or white and may be spotted with black in the smaller toads. The under part of the hind leg is grayish. The legs may be barred or spotted with black. The conspicuous marks of this toad are the small, round parotoids, the broad interorbital area, the sharp edged often pebbly canthus



rostralis giving the nostril a "boxed" appearance. The eyelids also are so tubercular as to appear pebbly. It is a fine little toad of very neat, compact appearance. We picked up one and turned it over. It lay in the shallow water with legs drawn up as if to "possum." We never saw any *Bufo* feign this lifeless attitude more than this individual. It frequently gives a pleasant bird-like chirp in captivity.

Structure: No cranial crests, or crests obscure; parotoids small and round; interorbital area broad; ridge from nostril to eye sharp and often pebbly, giving the nostril a "boxed" appearance; finger excrescences of males not prominent; throat of male somewhat discolored.

Voice: The vocal sac of the male is a round subgular pouch. The call is bird-like. It is a high pitched, yet very pleasing trill, lasting while one counts 15-25.

Breeding: They breed from April to July, May being the most common month. The eggs are single with very sticky jelly and sometimes the eggs are stuck together loosely as a small film on the bottom. The envelope is single $1/8$ inch (3.2-3.6 mm.), the black and white vitellus $1/25$ - $1/20$ inch (1-1.3 mm.). The eggs hatch in 3 days or less. The small tadpole, 1 inch (24-25 mm.), has a very black body, and a whitish tail with many evenly spaced black dots. The tooth ridges are $2/3$. After a tadpole period of 40 to 60 days, they transform from June to August, at $2/5$ inch (9-11 mm.).

Notes: July 19, 1917. From 5-7 p. m. at Texas Pass, Arizona. We heard plenty of toads but could not find them. At last, Munz and I dug a croaking male from beneath a rock. They croak in the crevices and underneath rocks. In the pools are plenty of tadpoles large and small. . . . In the evening we picked up a female *B. punctatus*. In the canyon were no end of males in the water and along the banks, males seizing each other. As yet there are few females.

Aug. 2, 1917. We started down Bright Angel Trail at Grand Canyon. At Indian Gardens, in a flat shallow area, water 6 inches deep, shaded on the east half at midday, with plenty of algae, on the muddy bottom, we found two egg complements of *B. punctatus*. They were near the west edge in shallow water and not under overhanging willows, and not in the water cress. The eggs were more or less agglutinated on the bottom about one egg deep, in a few places more. Later, we found no end of complements in all stages and took three or four transformed stages of *Bufo punctatus* here.

May 9, 1925. Helotes, Tex. At Marnock's second crossing, we arrived about 10 p. m. No end of males were hopping around on the concrete flat crossing. They were restless. We tried for an hour before we got a photograph. They were fond of getting on a stone for croaking. In most cases the pairs were on the banks.

Oak Toad. Oak Frog. Dwarf Toad.

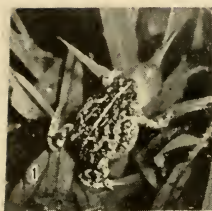


PLATE XXII. 1, 2. Males croaking ($\times \frac{3}{4}$). 3, 8. Males ($\times 1$). 4, 6, 7, 9. Females ($\times 1$). 5. Egg bars ($\times \frac{2}{3}$).

Bufo quercicus Holbrook.

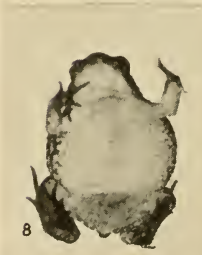
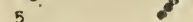
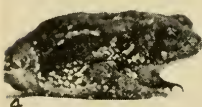
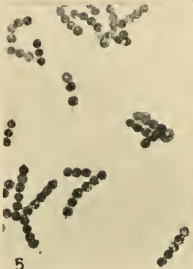
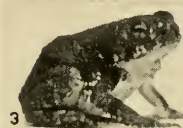
Range: North Carolina to Florida west to Louisiana.

Habitat: Pine-barrens.

Size: Adults, $3\frac{1}{4}$ – $1\frac{1}{4}$ inches. (Males, 19–30 mm. Females, 20.5–32 mm.).

General appearance: This pigmy toad has a light stripe down the back, and 4 or 5 pairs of unconnected spots along the middle of back from the first pair between the eyes to the last which are merely two pinpoints just ahead of vent. They may be light brown or almost black so that the spots barely show. The skin is finely roughened with tubercles, many of which are red. This brightly colored little fellow looks like a bit of velvet or tapestry. The arms and legs are barred with black. The vocal sac of the male is conspicuous when deflated, and is a triangular apron with the base on the gular line, and the point extending backward over the pectoral region. Under parts grayish or buffy.

Structure: Head to angle of mouth short; snout pointed; body short; flat; hind limbs shorter than body length; first finger less than or equal to second; cranial crests di-



vergent, ends connected by transverse series of raised warts, giving the cranial hollow a parapet behind; parotoids, finely spinose; excrescences on fingers of male not prominent; interorbital region broad.

Voice: The vocal sac of male is an oblong "sausage." When deflated it is made up of folds of skin on the lower throat covered by a conspicuous apron or lapette. The call is very bird-like, not frog-like. It is a very high pitched whistle. The chorus is deafening and can be heard 1/8 mile or more.

Breeding: They breed from May 15 to August 15. It takes a heavy warm rain to start these little toads to calling vigorously. The eggs are in bars of 2, 3, 4, 5 or 6 eggs, and are from 1/12-1/4 inch (2-7 mm.) long, and 1/20 inch (1.3 mm.) wide. The eggs, black and white, 1/25 inch (1 mm.) in diameter, are laid on the bottom of shallow pools. The small tadpole is grayish with six or seven black saddles on the musculature, and with heavily marked upper tail crest and the venter is one mass of pale purplish vinaceous. They transform July 13 to August 16, at 1/4-5/16 inch (7-8 mm.).

Notes: June 4, 1921, Billy's Island, Okefinokee Swamp. About 2 inches of rain dropped and the island seemed teeming with oak toads. They bred almost everywhere. All about the cleared fields, in piney woods, in hammocks, and numerous other places, we found oak toads that day. On July 3, the species was abroad in great numbers. Every transient shallow pool filled by the rain had them calling. We took 3 or 4 pairs and 30-40 males in short order.

On July 27, 1922, in a shallow pond, we heard so many oak toads we looked for eggs. We found single bars of 2-6 or 8 eggs rarely attached to sticks at the surface, usually attached to grass blades 0.5-1 or 2 inches below the surface of the water, the water 1-3 inches deep. Other bars were attached to pine needles. Once in a while two bars extended out from a common focus. Normally they were close together.

May 16, 1921. The oak toad male was calling before we approached. He piped only lowly. . . . His note is surely very bird-like. One will hear three or four calls like a piping chicken. Sometimes the note is repeated three or four times. Then the process is repeated after a very short interval. Once the note was likened to that of a swallow-tailed kite. It is truly the most unfroglike note I ever heard. It is high pitched and sometimes sounds like some animal in distress.

May 26, 1921. Billy's Island. In pipewort, sedge and grassy places at 10 a. m. found a female *Bufo quercicus*. We hear males in the woods. The calls are more lively and insistent. Is *B. quercicus* going to the ponds soon? We have taken four or five toads this morning. Females are about more since last night's thunderstorm. . . . In a burnt-over area it seemed as if more were present. Possibly they are easier to find in this area. We found 3 males and 3 females. The males are not in holes.

Southern Toad. Carolina Toad. Grey Toad.

Land-frog (Bartram).
Land-toad (Catesby).
Latreille's Toad. Charming Toad. Hop Toad.

PLATE XXIII. 1. Male ($\times \frac{3}{5}$). 2. Male ($\times \frac{3}{4}$). 3, 4. Males croaking ($\times \frac{1}{4}$). 5. Female ($\times \frac{3}{4}$).

Bufo terrestris (Bonnaterre).

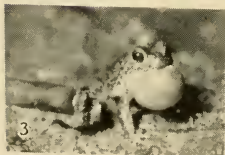
Range: North Carolina to Florida, west to the Mississippi River.

Habitat: Particularly abundant in cultivated fields. Breeds in shallow water, sometimes tiny transient pools, sometimes the edges of lakes.

Size: Adults, 1 $\frac{5}{8}$ –3 $\frac{5}{8}$ inches. (Males, 42–82 mm. Females, 44–92 mm.).

General appearance: They vary in color from red or gray to black. The crests on the head are prominently raised at the rear into club-like prominences or knobs. The skin between the larger warts is finely and uniformly roughened with tubercles all over, including the eyelids and parotoids.

Structure: Prominent knob-like crests; backs of thumb and second finger of male have excrescences and also on inner edge of the third finger; female throat usually light; male throat usually dark; pectoral region may be heavily spotted, sometimes only a median spot.



Voice: The note sounds much like our droning *Bufo americanus* of the north, not like the scream of *Bufo fowleri*. The trill is perhaps shorter than that of *B. americanus*. The trill lasts 7-9 seconds, with intervals of 4-60 seconds. It is musical in character. It has been described as a high trill, a drone, or even a bass roar, for when many are calling close to the observer, the sound is deafening. The choruses can be heard some distance away. Just as in other species, they may give weak notes; individuals may be freakish, hesitant, shrill, or even rarely open the mouth to scream, or with half inflated throat give puzzling notes. Usually when croaking, the throat is distended to its full capacity with the body compressed. Then the body is distended and the throat collapsed.

The calling toads in cypress ponds and bays may be perched on a log, on a cypress knee, stub or stump, at the base of a cypress or gum tree, on the moss, or resting on aquatic plant stems, leaves, or dead twigs, usually in shallow water or at the edge of a pond. In overflow pools, it may be anywhere in shallow places. Rarely if ever does it float when croaking. It is truly an alert, pert animal.

Breeding: They breed from March 1, or earlier, to September. The eggs are in long coils of jelly, the egg $1/25-1/16$ inch (1-1.4 mm.), the outer tube $1/10-3/16$ inch (2.6-4.6 mm.), the inner tube $1/12-1/8$ inch (2.2-3.4 mm.). The eggs, separated in the tube and with no partition apparent between them, number 2500-3000, and hatch in 2 to 4 days. The small tadpole, 1 inch (26 mm.), has the body broader toward the rear, the tail crests narrow, the tail short, rounded, and the eyes dorsal, close together, and is black in color. The tooth ridges are $2/5$. After a tadpole period of 30-55 days, they transform from April to October, at $1/4-1/2$ inch (6.5-11 mm.).

Notes: "The toad itself, however, is differently built, (from *B. americanus*) the head being wider and higher, and the arms and legs shorter and more delicate. The eyes, also, are larger and the enormous bony knobs on the large heads of some old females give them a sort of resemblance to species of the tropical Cystignathoid toads *Ceratotophrys*. Unlike the latter, our toads are gentle creatures, living their lives of usefulness in our farms and gardens." (R. F. Deckert, Copeia, 1914, p. 2).

In many transient or shallow pools the egg strings are strewn on the bottom. More often the egg strings are attached to or woven about grass, vegetation, twigs or other support in the water. In one pond, we found them in a clear area, and edge of a pond next the *Pontederia* zone amongst scattering *Sagittaria* and other water plants. These made a mat about which the eggs were woven. Sometimes they are fastened near the surface in deep pools or along lake edges. The eggs are in long files which are often several feet in length.

Nebulous Toad. Wiegmann's Toad. Mexican Toad.

PLATE XXIV. 1, 2, 4. Males ($\times \frac{2}{3}$). 3. Male croaking ($\times \frac{1}{3}$).

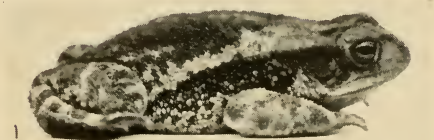
Bufo valliceps Wiegmann.

Range: Louisiana, eastern and south central Texas to Costa Rica.

Habitat: Lowlands in the West Gulf Coastal Plain of Louisiana, in the hills in northwestern Louisiana, in the pine lands of eastern Texas, open stretches of streams in central and southern Texas. Frequently found in railroad ditches or roadside pools.

Size: Adults, 2 $1/8$ –5 inches. (Males, 53–98 mm. Females, 54–125 mm.).

General appearance: This is a large brown toad, with a light streak down the middle of back from snout to vent, a light area over each parotoid and extending diagonally backward to the groin. This light lateral area is bordered below with a fringe of white conical tubercles. The skin of back and venter is closely set with tubercles. The venter may be a uniform dirty white or buff or speckled with dark in varying degrees. There is a light line on the upper lip continued beyond the rear of the angle of mouth by another row of light tubercles. The throat of the male is discolored, a citrine drab or water green.



Structure: High projecting crests on crown of broad head; these are canthal, preorbital, supraorbital, postorbital, parietal, and orbitotympanic ridges; parotoids rather small, round or triangular; snout obtuse; toes $1\frac{1}{2}$ webbed; interorbital space wide; internasal space narrow; upper eyelid much less than interorbital space; male with a subgular vocal sac not revealed by wrinkles on the throat; body flat; mouth large; excrescences on two fingers of male prominent.

Voice: The vocal sac is a large round, subgular pouch. The call is louder, harsher, and lower in pitch than *Bufo americanus*. The croak lasts 3-4 seconds. Often the males take stands several feet up from the pond's edge.

Breeding: They breed from March to August. The eggs are often in double rows in long strings of jelly with the wall of the inner tube close to outer. This jelly grows looser with age, so that there may be a double row of 25-27 eggs in $1\frac{1}{5}$ inches (3 cm.) or a single row of 7-10 eggs in $1\frac{1}{5}$ inches (3 cm.). The outer tube is $\frac{1}{8}$ inch (3 mm.), the inner tube $\frac{1}{10}$ inch (2.6 mm.) and the vitellus $\frac{1}{20}$ inch (1.2 mm.). The eggs are purplish black and hatch in $1\frac{1}{2}$ -2 days. The small blackish tadpole has 8-10 black bars with intervening pale buff areas on the dorsum of the tail musculature. The tooth ridges are $\frac{2}{3}$. After a tadpole period of 20 to 30 days, they transform, April to September, at $\frac{5}{16}$ - $\frac{1}{2}$ inch (7.5-12 mm.).

Notes: May 6, 1925. Helotes, Texas. Tonight at 9 p. m., as we approached the pond, we espied a small head of *Thamnophis proxima*. A few moments later two larger water snakes were close together. They were after a nearby croaking toad. A little farther on we heard two male *B. valliceps*. Presently we saw something rolling over and over in the water. It was a water snake. In the semi-darkness, I scooped up the snake and all. The snake dropped a toad. The toad hopped limply away. Farther on we found a young *Natrix rhombifera* beside another pair.

May 13, 1925. Helotes, Texas. We found *B. valliceps* egg strings widely spread out. These were long strings in mid-water and buoyant in mid-plane of the water. . . . One bow of two strings three feet long was attached only at the ends. These eggs covered an area of 6 feet square.

April 22, 1925. San Benito, Texas. Pond in a mesquite region. On the east side of this beautiful blue water lily pond we found *B. valliceps* on the moist earth, transforming. Soon after transformation the toads show the light line of tubercles on the side and the white spot below the eye. They do not show the furrowed interorbital at this small size.

The Rocky Mountain Toad. Woodhouse's Toad. American Toad.

PLATE XXV ($\times \frac{1}{2}$). 1, 2. Females. 3, 4. Males.

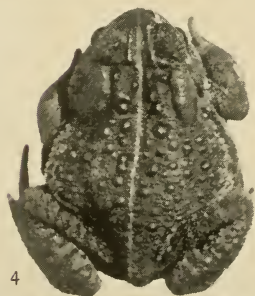
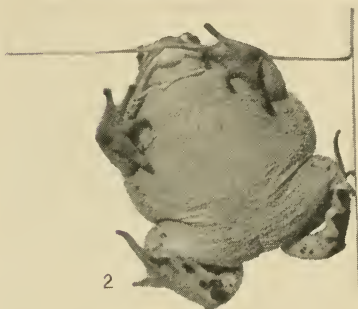
Bufo woodhousii Girard.

Range: Montana to Texas, west to southeastern California. Great Plains and Great Basin region.

Habitat: This toad lives in canyons in mountains and out on plains along irrigating ditches. It is also found along rivers and in swamps. In fact its habitat is very diverse, being any habitat where sufficient moisture obtains.

Size: Adults, 2 $\frac{1}{4}$ –4 $\frac{3}{4}$ inches. (Males, 56–99 mm. Females, 58.5–118 mm.).

General appearance: This toad looks much like our eastern *Bufo americanus*, but is larger. The general color is grayish drab on the back, with several large brownish warts which are usually surrounded by a slightly larger blackish area. There is a narrow light mid-dorsal stripe. The sides are marked with several black spots. The crests on the head are dark in color, but not particularly conspicuous. They form a right angle around the rear of the eye. The parotoids are large and oblong. The under parts are a dark cream color. The tubercles and tips of fingers and toes are reddish brown. The head is short and



thick. The color description of a female taken at Ephraim, Utah, Aug. 19, 1929, is as follows: The back is light grayish olive becoming on the sides and fore and hind legs tea green; the tympanum, pea green, the parotoid, vetiver green or light grayish olive; the crests are clove brown or fuscous; the spots on upper parts are fuscous becoming on sides dark ivy green or dull greenish black. There are no very regular spots on either side of the back. Each fuscous spot on dorsum is warty centered, the wart being drab or hair brown. On the sides, the spotting is more pronounced and wart-centered. The forearm has at least two oblique cross bars; the tibia has two or three indistinct cross bars; the under parts are deep olive buff or cream buff; the under side of hind legs is pinkish cinnamon. The iris is fuscous spotted with vinaceous cinnamon and sulphur yellow or marguerite yellow. The marguerite yellow pupil rim is broken behind and in front.

Structure: Cranial crests, prominent, forming right angle back of orbit; longitudinal ridges almost parallel; supratympanic or pre-parotoid ridge absent; parotoid glands long, slender, divergent; interparotoid space more than twice the interorbital space; two metatarsal tubercles, one very large, one very small; throat of male black from line of angle of mouth forward; first finger slightly longer than second; large warts on back, each with several pits; this toad is larger than *B. americanus*.

Voice: The vocal sac is a rounded throat pouch. The call is a vibrating note of high pitch, sweet and musical.

Breeding: They breed from March to July. The eggs have not been described and the tadpoles are little known. They transform March 25 to September at 2/5-3/5 inch (10-13.5 mm.).

Notes: July 9, 1917. Western Texas. Quite a rain near Sierra Blanca. The toads are large forms. They are *Bufo compactilis*, *Bufo c. cognatus* and *Bufo woodhousii*.

July 24, 1925. At Duncan, Arizona, the engineer at the electric light plant told me of several 'big' toads at the plant. We went over. They were all female *Bufo woodhousii*. He said they would hop up on the door sill and wait for insects to drop from the wall below the light. Why are they all females? Have the males gone to ponds since the recent rains? All these females are ripe, not spent.

"Coche County, Utah, August 1921. Among these enemies of the sugar-beet webworm were astonishing numbers of our common toad, *Bufo woodhousii* Girard. Most of the toads were of this year's brood, ranging in length from one and a fourth to one and a half inches. I would estimate that in one field of about one square acre there were no fewer than one hundred toads. . . . These small toads contained from 24 to 40 worms each, the limiting factor in quantity being the size of the stomach." (Pack, Copeia, 1922, p. 46-47).

Cricket-frog. Savanna Cricket. Savannah

Cricket. The Cricket Hylodes. Peeper. Rattler. West Cricket Frog (*crepitans*). Savannah Cricket Frog. Cricket Toad. Little Grey Speckled Frog (Bartram). Grasshopper-frog. Knee-deep.

PLATE XXVI (×1). 1, 3. Females. 2. Male. 4. Tadpole. *Acris gryllus* (Le Conte).

Range: Long Island, N. Y., to Florida, west to Trans Pecos, Texas and eastern New Mexico; northwest to Nebraska, Colorado and Canada, and northeast to Ohio and Ontario.

Habitat: Terrestrial, shade-loving frog. In meadows or about creeks or ponds in the open vegetation mats or wooded edges.

Size: Adults, $3\frac{3}{5}$ – $1\frac{1}{3}$ inches. (Males, 15–29 mm. Females, 16–33 mm.).

General appearance: This is a small tree-frog, but looks like a small true frog (*Rana*). It varies in color, black, dark brown, reddish brown, light brown, green, or gray; or the markings may be reddish on a green ground. Between the eyes there is usually a dark triangle, white bordered behind. This species possesses rear femoral stripes, oblique bars on the sides, light spots on the jaw, and an oblique



white stripe from the eye to the arm. The skin is more or less tubercular.

Structure: Tympanum indistinct; tympanic fold present; fold across breast frequently present; disc small; hind leg very long; tibia very long.

Voice: The call is a rattle, or like some metal clickers, *gick, gick, gick*, or *kick, kick, kick*, in rapid succession.

Frequently one finds the males with inflated vocal sacs even when not calling. When calling, the throat is never fully deflated. After a call it may be swollen to three quarters its full capacity. Then when the call is given, the body sides are compressed and the vocal sac is extended to its limit.

Breeding: They breed from February to October. The single eggs are few, 250, are brownish and white and are attached to stems of grass in shallow water or are strewn on the bottom. The egg, $1/25$ inch (0.9–1.0 mm.) has a single envelope $1/10$ – $1/8$ inch (2.4–3.6 mm.). The dark olive tadpole is medium $1\ 11/16$ inches (42 mm.), full and deep bodied, its tail long with acuminate tip and with a black flagellum. The tooth ridges are 2/2. After a tadpole period of 50 to 90 days or longer, they transform from April to October at $2/5$ – $3/5$ inch (9–15 mm.).

Notes: June 15, 1917 at Dinwiddie, Va., we found this species breeding. They had chosen a shallow grassy meadow pool, 1–4 inches deep. The eggs were attached singly to sedge stems or were strewn singly on the bottom. In one or two cases, three or four eggs were close together. Many of the eggs were in water not more than an inch deep. The eggs are firm. We found no more than 10 eggs.

April 23, 1921. Okefinokee Swamp, Ga. Sometimes these frogs are black on black soil, some brown—on brown pine needles, sometimes green all over except for dark marks, sometimes gray over drier sand, or reddish brown, even on the back of fore limbs and hind limbs.

April 25, 1921. *Acris* males jump 3 feet at a time on the water's surface.

May 17. They leaped into bushes $1/2$ –1 foot high.

Cricket Frog.

Acris crepitans Baird.

We have not attempted as yet to separate all the puzzling *Acris* into *Acris gryllus* and *Acris crepitans*. The authority who from location, personal field experience, and from interest may possibly succeed in accomplishing this task is Mr. Percy Viosca, Jr., of New Orleans.

We spent June 10 and 11, 1930 in the field with Mr. Viosca. Our journal note of that date reads: *Acris gryllus* he calls a pine barren Atlantic coastal form extending to the Florida parishes of Louisiana, while *Acris crepitans* he holds a Mississippi valley or more western form. *Acris gryllus* is a form of shade, *A. crepitans* an open water form of water lily areas, water hyacinth fields, etc. *A. crepitans* has two prominent white tubercles below vent. *A. crepitans* has shorter snout than *A. gryllus*, more webbed fourth toe, and snout outline different. Viosca holds their notes different and illustrated the difference with coins or stones and pointed out the two when calling, but as yet we are not proficient enough to separate the two if we be apart from him.

Chorus Frog.

PLATE XXVII. ($\times 1$). 1-7.
Males.

Pseudacris brachyphona
(Cope).

Range: Southwestern Pennsylvania (Cope and Netting), southeastern Ohio (Walker), western Maryland (Dunn), eastern Kentucky to extreme south of West Virginia (P. C. Bibbee, R. K. Brown and A. H. Wright).

Habitat: Springy hillsides, grassy pools, ditches, sources and along upper courses of upland rivulets,—more hilly than lowland habitats.

Size: Adults, 1-1 $\frac{3}{8}$ inches. (Males, 26-30 mm. Females, 27-34 mm.).

General appearance: These are small frogs, gray or brown in color, medium in size for *Pseudacris* and with the most distinct digital disks of this genus. They are more stocky in body and broader in head than *P. n. triseriata* and *P. n. feriarum*. The usual mid-dorsal stripe or row of spots is lacking. They often have a light mid-dorsal area somewhat after the pattern of the cricket frog (*Acris gryllus*). The interorbital triangle is not white-edged behind. The dorso-lateral bands curve from the eye to mid-back to groin, making two crescents. They often meet in mid-back to form a cross or transverse bar. Sometimes the pattern consists of a cross



or a bar alone.

Structure: Original description. "A specimen of nearly the size and form of *Hyla femoralis* was taken in west Pennsylvania, near the Kiskiminitas River. In proportions it does not differ from the *Feriarum*, but the toes are fringed, the dilations larger and the coloration different. Above blackish-ash, abruptly defined on the sides. Lateral band not extending beyond tympanum. No median dorsal band, but two black dorso-laterals of double ordinary width converge from each tympanum and extend to end of urostyle inclosing with the inter-orbital triangle a narrow, anteriorly bifurcate dorsal band of ground color." (E. D. Cope, 1889, p. 341).

Voice: "The note of this species is quite different from that of the *C. triseriatus*, not being continuous, but in sets of crepitations repeated in time and at intervals." (E. D. Cope, 1889, p. 341). When *P. n. triseriata* and *P. brachyphona* are calling they are different, the latter has a faster, higher note yet its call belongs distinctly in quality and form with the *P. nigrita* group.

Breeding: They breed from March to May and possibly into June. Mr. C. P. Walker (1932) records eggs March 14 to April 16, and says they are in masses, attached to vegetation or trash in water. The tadpole has not been described. Of transformation we have no data.

Notes: July 18, 1931, Beckley fair ground woods, W. Va. The botanists found a queer *Pseudacris* near a sawdust pile.

July 19, 1931, Beckley. Tonight after a heavy rain, in a puddle beside the grandstand and in pools beside the track we heard several *Hyla versicolor* and in the distance several *Hyla crucifer*, but this note which drew us to the spot was new. Surely a *Pseudacris* in character of voice, neither a *Hyla crucifer* nor an *Acris*. It is different from *P. n. triseriata* and *P. n. feriarum*. . . . When we first caught it, its long legs reminded us of *Acris* and we looked for the rear femoral stripes. They were not present. It seems a *Pseudacris*, but has too large disks. Must look up Cope's *P. f. brachyphona*.

July 21, 1931. Prof. P. C. Bibbee of State College, Athens, W. Va., brought us . . . swamp cricket frogs. They have such queer coloration. . . . They take them in the early spring. The frog has a vittal stripe. The hind limbs and tibia are long.

In general color they range from the sorghum brown or deep brownish drab or mars brown of *Hyla femoralis*, to some of the grays found in *Acris* or *Hyla femoralis* or the blackish and olive of *Pseudacris n. triseriata*.

Compared to *P. ornata*, *P. n. feriarum*, *P. n. triseriata* it has a wider head, longer hind limb, tibia, and foot with tarsus. In more ways it falls into the *Pseudacris ornata* group; in some respects with the *Pseudacris nigrita* group.

Swamp Cricket Frog. Swamp Chorus Frog.

Swamp Tree Frog.
Swamp Tree-toad.
Striped Tree-frog.
Rough Chorus Frog.
Black-spotted Tree
Frog. Black Tree Frog.
Black Swamp Frog.

PLATE XXVIII. (×1). 1-6.
Males.

Pseudacris nigrita nigrita
(Le Conte).

Range: South Carolina to
Mississippi, possibly into
Louisiana.

Habitat: Breeds in ditches,
ponds or bayous, and later
moves to dryer hammocks
and ridges of the pine bar-
rens.

Size: Adults, $4\frac{1}{5}$ - $11\frac{1}{5}$
inches. (Males, 21-28 mm.
Females, 22-30 mm.).

General appearance: This
small frog has a slender body
and pointed snout, prominent
eyes and long legs. The skin
is finely granulated. This
form has the most numerous
small dorsal spots of any
Pseudacris. It is gray or olive
to black in color, with three
irregular rows of dark spots
on the back and darkly
mottled sides. The dark spots
are outlined with white dots.
The row of dark spots down
mid-back divides into two
rows toward the rear. A light
line is present along the jaw
with a dark area extending
from the snout through the



eye and beyond the tympanum. There is a light speck back of the tympanum. The legs are barred with black spots. There is no triangle or cross bar between the eyes. The male has a dark greenish yellow throat with longitudinal folds in the middle.

Structure: Slight webs at bases of second, third, and fourth toes; slight disks at tips of fingers and toes; hind legs long; in many ways this is the most distinctive of all five subspecies of *P. nigrata*.

Voice: Its call is a shrill metallic trill, *ic, ic, ic, ic, ic*.

Breeding: Within the last two or three years, several naturalists in the south have made notes on the breeding of this early species. At Biloxi, Mr. M. J. Allen found it on Dec. 15, 1929, and also on Jan. 20, 1931. On Feb. 7 and Feb. 15, 1932, Mr. O. C. Van Hyning records it at Gainesville, Fla. On Jan. 20, 1933, Mr. H. A. Carter of Decatur, Ga., writes that he is following the breeding habits of *P. n. nigrata*. And on Feb. 4, 1933, at Gainesville, Florida, Messrs. A. F. Carr and H. K. Wallace found this species breeding at the same time as *P. ocularis* and *P. ornata*. The eggs they sent us are brown and cream or white, the vitellus $1/25$ inch (0.9–1 mm.), the single envelope $1/10$ – $1/9$ inch (2.6–2.8 mm.).

Notes: July 15, 1922. Folkston, Ga. On high sandy ridge south of Spanish Creek, we were looking carefully and gingerly at a much serrated poison ivy plant, and saw something jump amongst it. We thought it a grasshopper, but soon found it to be a frog. It was *Pseudacris n. nigrata*. We took its picture right there. . . . It would leap amongst dead leaves, amongst wire grasses and amongst the ivy. On February 7, 1932, O. C. Van Hyning of Gainesville, Fla., wrote us: "I went out into the middle of the Prairie . . ., and caught eight males and one female of *P. nigrata*." Feb. 15, he wrote: "I have one bunch of eggs laid in the laboratory."

Detailed color description of a female taken at Gainesville, Fla., by O. C. Van Hyning, Feb. 5, 1932, follows: Top of snout, upper eyelid and foreback, yellow citrine or light yellowish olive, becoming on rear back and sides and the interstices of fore legs and hind legs veronese green, kildare green, or light grape green. The three dorsal rows of black spots are distinct, those of the sides less regular. Vitta from snout through eye to past tympanum, black. At rear of tympanum the whitish or light grape green spots begin. Light stripe on jaw may be continuous or interrupted. It may be white, pale veronese green or even have the background color of the back. The whole venter is very granulate, the belly being white, the sides of the belly, venter of fore limbs and throat with a wash of sulphur yellow or light green yellow. The front and rear of thighs, olive lake or old gold. Eye black with a light green upper edge to pupil.

Clarke's Striped Tree Frog. Striped Tree

Frog. Striped Chorus
Frog.

PLATE XXIX. ($\times 1$). 1, 3,
7. Females. 2, 6. Males. 4.
Eggs attached to small twig.
5. Tadpole.

Pseudacris nigrita clarkii
(Baird).

Range: Texas to Kansas.

Habitat: Abundant in vi-
cinity of marshes. Breeds in
roadside ditches, shallow
water lily ponds, shallow
mesquite ponds, grassy ponds
or other transient pools.

Size: Adults, $3\frac{1}{4}$ – $1\frac{1}{4}$
inches. (Males, 20–29 mm.
Females, 25–31 mm.).

General appearance: This is
a small grayish or olive frog
with dark longitudinal spots,
or these spots may be ar-
ranged in three stripes. A dark
lateral banding extends to the
nostril. There is a light stripe
on the upper jaw. The legs are
barred above and white or
pale buff beneath. Ventrals
are white or ivory yellow
with the throat of the male a
dark olive buff. They are
protectively colored little
things in the grassy edges of
the ditches where they call
and breed.

Structure: Snout acute,
projecting beyond lower jaw;
toes slightly dilated at tips;
male throat with one to three
longitudinal folds.

Voice: Its call is a grind-
ing note, more measured, and



not so shrill as *Acris*. It is raucous and grating, *it-it/it-it/it-it*, sometimes 60 times without a stop, sometimes uniform, sometimes double speed. They call from under the grass edges. Sometimes there is a synchronized chorus of sawing notes.

Breeding: They breed with the spring rains, March 5–May 20. The citrine drab and ivory yellow eggs are in a loose irregular mass attached to plant stems, their number few, 150–175 eggs. The egg is $1/32$ – $1/25$ inch (0.65–0.9 mm.), the outer envelope $1/12$ – $1/10$ inch (2.2–2.4 mm.) or more loose and irregular, the inner envelope $1/16$ inch (1.4–1.8 mm.). The grayish olive tadpole is small, $7/8$ – $1\ 1/5$ inch (23–30 mm.), its crests nearly transparent, the tooth ridges $2/3$. After a tadpole period of 30 to 45 days, they transform, April 1 to June 20, at $5/16$ – $1/2$ inch (8–13 mm.).

Notes: April 22, 1925. San Benito, Texas. In sedges around a pond one mile south of San Benito, these little transforming frogs were swimming in shallow water. As we try for them, they often duck. They are hard to collect without hurting them, they are such delicate little creatures. They can turn their heads like some other *Pseudacris*. Found only a few tadpoles in the pond. The species must be through metamorphosis here. This is a beautiful blue water-lily pond.

Detailed color descriptions of a male and female taken at Beeville, Tex., March 26, 1925, follow: A pair which laid.

Female. Back deep olive-gray; on sides pale olive-gray above lateral stripe. Spots on back hellebore green surrounded by black. Stripe through eye and along side dark grayish olive. Bars and spots on fore limb like lateral stripe. Stripe on upper jaw cartridge buff with marguerite yellow or primrose yellow in it. Tympanum, brownish olive or light brownish olive. Venter white or pale olive buff or ivory yellow. Under side of hind legs light grayish vinaceous or light brownish drab. Iris—upper part of rim marguerite yellow or primrose yellow, rest dotted black and primrose yellow and cinnamon drab.

Male. Background pale smoke gray also areas of tea green. Spots vetiver green, surrounded by black. Lateral stripe, bone brown. Tympanum, army brown. White or primrose yellow spots on tubercles below vent and on basal insertion of thighs. Throat discolored dark olive buff or more yellowish. Two longitudinal plaits in middle of throat. Iris of this male has also some avellaneous in it and a tendency to a dark lateral bar through it to complete nasal and lateral stripe.

March 25, 1925. In the two pairs which laid, the females were more spotted, the males more striped. Is this a natural tendency or an individual variation?

March 24. The male of a third pair is very much striped. Another male we captured is very much spotted.

Eastern Swamp Cricket Frog. Swamp Tree

Toad. Swamp Tree Frog.
Chorus Frog. Striped
Treefrog. Common
Chorus Frog.

PLATE XXX. ($\times 1$). 1, 2, 6.
Females. 3, 5, 7. Males.
4. Eggs.

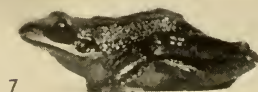
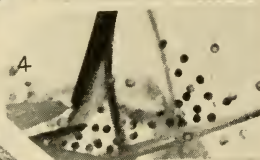
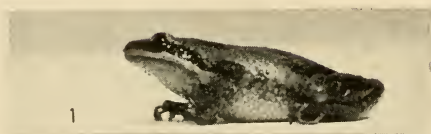
Pseudacris nigrita feriarum
(Baird).

Range: New Jersey, Penn-
sylvania to North Carolina,
and possibly into South Caro-
lina.

Habitat: Breed in marshy
stretches, shallow ponds or at
edges of ponds where there is
matted vegetation, sedgy
clumps or moss.

Size: Adults, $4\frac{5}{8}$ – $1\frac{1}{3}$
inches. (Males, 21–30 mm.
Females, 22–33 mm.).

General appearance: These
are small frogs with pointed
heads, extremely long fourth
toes, very little or no webbing
between the toes and with
small disks on their toes.
They are grayish olive or
brown. There is a dark tri-
angle between the eyes which
extends backward as a dorsal
stripe, with another stripe on
either side. A dark stripe ex-
tends through the nostril and
eye to the shoulder. This is
bordered below with a light
stripe on the upper jaw. The
throats of the males are
usually dark but not always
so. The under parts are a
buffy cream color.



Structure: "Femur and tibia and hind foot about equal, and half the length of the body." (S. F. Baird, 1854, p. 60).

Voice: A penetrating and grating *it-it/it-it*/is given many times without a stop. "Its note resembles that of *Acris* in being crepitant, and differs from the toned cry or whistle of the *Hylae*. It is not so loud as the former and is deeper pitched; it may be imitated by drawing a point strongly across a coarse comb, commencing at the bottom of a jar and bringing it rapidly to the mouth; or, better, by restraining the voice to the separate vibrations of the vocal cords, and uttering a bar of a dozen or twenty vibrations, beginning with the mouth closed and ending with it well opened." (Cope, 1889, p. 345).

Breeding: They breed from February to May 10. The black and cream eggs are in irregular loose jelly masses attached to the stems of matted vegetation. The egg is $1/25$ inch (0.9–1.1 mm.), the single envelope $1/8$ – $1/6$ inch (3.2–4 mm.). The envelope in the mass becomes larger and irregular. The small tadpole, $1-1\frac{5}{16}$ inches (25–33 mm.), has the tail medium, with tip acute or acuminate, and is blackish or olive in color with bronzy belly. The tooth ridges are $2/3$. After a tadpole period of 50 to 60 days they transform until mid-June, at $5/16$ – $1/2$ inch (8–12 mm.).

Notes: April 4, 1929, Carlisle, Pa. We found a surface pond at the edge of town, and heard and caught 3 *Pseudacris* here.

April 6. We started up North Mountain, Carlisle. . . . Just before Indian Springs, we heard a great chorus. . . . On the hillside, beside the road in an open field was a springy area. . . . We saw two little fellows with their amber throats so distended that they showed from the rear. They were sitting in the mat of vegetation, a little ways from a tussock, with their heads held up vertically, above the water. The stream area was fairly deep but filled with a mat of grassy vegetation. We rolled this back a bit at a time and caught an occasional frog in the tangle. The irregular egg masses were common in this mat.

Detailed color description of a female from North Mountain, Carlisle, Pa., follows: Upper part of head, back, fore and hind legs, russet, hazel, verona brown or warm sepia. Under side of hind legs benzo brown, drab gray or brownish drab. Under parts of body cream color becoming slightly massicot yellow or naphthalene yellow on throat. Stripe down middle of back, stripe either side of median stripe and faint spots on sides are black or chestnut brown, mummy brown or sepia. Stripe through nostril and eye to shoulder and beyond warm sepia or vandyke brown. Band around upper jaw extending backward beyond shoulder; below the dark stripe is warm buff, cream buff, or chamois. Iris, same color as vitta through eye, but dotted with mars orange or burnt sienna. These predominate in the upper half giving iris a "reddish" or "coppery red" appearance.

Northern Chorophilus. Northern Pseudacris.

Northern Striped Tree Frog. Spotted Tree Frog. Northern Spring Peeper. Peepers Frog. Swamp Whistler.

PLATE XXXI. 1, 3, 4. Females ($\times 1$). 2. Male ($\times 1$). 5. Female ($\times 1\frac{1}{8}$).

Pseudacris nigrita septentrionalis (Boulenger).

Range: Canadian northwest, Minnesota to Montana.

Habitat: Swampy borders of rivers, lakes, and ponds.

Size: Adults, $3\frac{1}{4}$ – $1\frac{2}{5}$ inches. (Males, 19–32 mm. Females, 19–35 mm.).

General appearance: Pembina, N. D. This is a small, long-bodied, short-legged tree frog. The snout is pointed. The color may vary from a gray to tawny or buff. The most prominent marks are the dark brown lateral stripe from snout to groin, and the light creamy stripe on the jaw below the eye. Certainly when seen at rest, you are impressed with the very short hind legs in sharp contrast with the long body. It has five darker stripes down the body. The median dorsal one may be broken into dots, the two latero-dorsal stripes are more constant and the lateral ones most prominent. The male has a greenish yellow throat, the female, a light throat. The legs of the female



are short and stout, those of the male longer and thinner. The under parts are greenish white.

Structure: Hind legs short.

Voice: Its call is like those of the more southern forms.

Breeding: They breed from May to early June. The eggs are in an irregular jelly mass attached to vegetation. The eggs are 1/20-1/16 inch (1.2-1.4 mm.). The tadpoles transform at about 5/16-1/2 inch (7.5-13 mm.).

Notes: Aug. 31, 1930. Pembina, N. D., Red River of the North. Along the shore is a mud flat baked and broken into squares. The cracks are deep and fairly wide. We walked along the shore, more or less abreast, Bert in the vegetation and I on the flats. I beat the bordering vegetation with a cane. . . . Suddenly my eye espied a small frog sitting at the edge of one of the clumps. As I looked, it jumped into a crevice. To my surprise it was a *Pseudacris septentrionalis*. We have been looking for suitable places for the search of this species at this dry period. Soon after, I saw a second clinging to the edge of another crevice. As we came close, it cocked its head on one side. A little later, a third appeared clinging to and crawling up the close-grown grassy edge bordering the mud flats. All three are females. In captivity they leap 2-8 inches. Description of a female from Pembina, N. D., Aug. 30, 1930:

The color of top of head, top of arms and legs and back between the three dorsal stripes is drab. The color between outer dorsal stripe and lateral band is a smoke gray or pale drab gray. The band extending from snout through eye, over tympanum to near groin is olive brown or brownish olive. This color is solid to the arm insertion then goes over a pebbly surface, the interstices of which are smoke gray or pale drab gray like the color above the band. The median and two latero-dorsal stripes are buffy brown outlined with dotted lines of olive brown. On top of head are a few specks of olive brown. The femur and tibia also have spots of olive brown, and on front of tibia and rear of foot and tarsus are half bars of the same color. On the upper jaw there is a prominent line of olive buff or chartreuse yellow bordered below, broadly on upper jaw and narrowly on lower jaw, by a finely punctate band which appears buffy olive or drab. Under surfaces are pale dull green-yellow, except for under side of hind legs which is light grayish vinaceous. All five stripes are continuous. The eye is olive brown except for the upper rim of pupil which is clear yellow green. The iris is dotted all over with clear yellow green and mars orange spots. The front, back, and lower margin of pupil is a succession of clear yellow-green dots. The lower margin of pupil rim is prominently interrupted below.

Three-striped Tree Frog. Swamp Cricket

Frog. Three-lined Tree Frog. Striped Tree Frog. Swamp Tree Frog. Peeper. Spring Peeper. Hay Frog. Little Tree-toad. Tree Frog. Chorus Frog. Little Striped Frog. Prairie Tree Frog. Striped Bush Frog. Treefrog Peeper.

PLATE XXXII. ($\times 1$). 1, 3, 5, 6. Females. 2. Male. 4. Eggs.

Pseudacris nigrita triseriata (Wied).

Range: Oswego, N.Y., west along the southern shore of Lake Ontario, west to north-eastern Arizona, Utah, Nevada, Idaho, and south to Arkansas and Louisiana.

Habitat: Low bushes and plants, and on the ground. Breeds in ditches, swamps, or temporary ponds.

Size: Adults, $4\frac{1}{5}$ – $1\frac{1}{2}$ inches. (Males, 21–32 mm. Females, 20–37.5 mm.).

General appearance: These are small, slender frogs with pointed heads, extremely long fourth toes and with small disks on their toes. They are brown or olive or grayish with a dark brown triangle, spot or stripe between the eyes. The most prominent stripe is one from the nostril through the eye, over the arm, and extending along the



side halfway to the groin. There are three dark stripes down the back, continuous, or more or less broken up, and dark spots on the legs. There is a prominent light cream or silvery line along the upper jaw. They are light cream or white beneath. Their skin is finely granular.

Structure: Vocal pouch round and subgular.

Voice: The call is a vibrating chirp.

Breeding: They breed from March 20 to May 20. The egg mass is a loose irregular cluster, the mass small, less than 1 inch in diameter, 20-100 eggs in the mass, 500-800 eggs in the complement. The brown or black and white egg is $1/25-1/20$ inch (0.9-1.2 mm.), the single envelope $1/5-5/16$ inch (5-7.8 mm.). The tadpole is small, $15/16$ inch (23 mm.), deep bodied with a long tipped tail, quite black with bronze on the belly and sides, and the tooth ridges $2/2$. After a tadpole period of 40 to 90 days, they transform in June at $5/16-7/16$ inch (7.5-11 mm.).

Notes: Color description of a female from Mrs. H. T. Gaige of Ann Arbor, Michigan. Sayal brown, tawny olive or wood brown back and upper part of fore and hind legs and tip of head. Stripes and spots bone brown or black or chestnut brown. These marks are: a triangle at the eyes extending backward a ways as a median stripe which may be interrupted and resumed and subdivided on rear back into two parallel lines; another band along dorso-lateral region from above shoulder to groin; and a stripe from snout through nostril, eye and tympanum halfway to groin. Tympanum, snuff brown or mikado brown. Stripe on upper jaw warm buff, cream buff with upper part light pinkish cinnamon below dark stripe through nostril and eye. Dark edge below this light stripe. This dark edge on labial border. Under parts as in *P. n. feriarum* from Carlisle, Pa., are cream color becoming slightly massicot yellow or naphthalene yellow on throat.

Iris same color as stripe along head with dottings of mars orange or burnt sienna. Over pupil rim is light yellow green.

Western Chorus Frog.

Pseudacris occidentalis (Baird and Girard).

Remarks: This form as *Litoria occidentalis* was first described by Baird and Girard in "A List of Reptiles Collected in California by Dr. John L. LeConte." We prefer to believe it was collected in California and that the name should not be assigned to a form of Texas or of the Southeast. All the other batrachians of the report were strictly western forms. Baird and Girard report *Hyla regilla* in this same paper, p. 301, first describe it in another place of this same volume (p. 174), and Hallowell also describes *Hyla regilla* in the same volume (p. 183) as *Hyla Scapularis*. Nevertheless, the *Litoria occidentalis* of this report might well be another variant specimen of the very variable *Hyla regilla*. At that period we have Hallowell in one paper (1854, pp. 96-97) describing *Hyla regilla* three times under three different names. We therefore suspect *Litoria occidentalis* of being a synonym of a western *Hyla* presumably *Hyla regilla*. A glance at the plate of the *Hyla regilla* will show at once how many resemblances this species has to *Pseudacris*.

Possibly some day it may result that what we have called *Pseudacris nigrata clarkii* from southern Texas to Kansas and what others have called *Pseudacris occidentalis* from northern Texas to Kansas may all be termed *Pseudacris nigrata occidentalis* or else *Pseudacris nigrata clarkii* or each may be reduced to the synonymy of *Pseudacris nigrata triseriata*.

Swamp Tree Frog. Swamp Cricket Frog.

Little Chorus Frog. Tree Frog. Savanna Cricket (Bartram). Least Swamp Frog.

PLATE XXXIII. 1, 4, 5, 7, 8. Adults ($\times 1\frac{1}{4}$). 2, 6. Males ($\times 1\frac{1}{4}$). 3. Male croaking ($\times 1$).

Pseudacris ocularis (Holbrook).

Range: North Carolina to southern Florida.

Habitat: Sphagnum edge of cypress pond. Grassy or sedgy area of pond or wet edge of pine barrens.

May 18, 1921, *Pseudacris ocularis* may start up from sphagnum edge of cypress pond or may start up from the ground. It will leap 1-1 1/2 feet at times. They sat on *Eriocaulon*, small *Sarracenia minor*, sedge and saw palmetto. We took a dozen of them. On June 25, we found them common in one pond, many in bamboo (*Smilax*) vines, on bushes some 4-5 feet up, others on level of water. July 15, 1921, we found them abundant in outer edges of cypress ponds, margins of cypress bays. Most of them we caught in the grass near the edge of ponds. June 17, 1922, we found them in grassy and sedgy areas on wet edge of pine barrens or outer edge of cypress bay or branch.

Size: Adults, 2/5-5/8



inch. (Males, 11.5-15.5 mm. Females, 12-17.5 mm.).

General appearance: These are the brownies of frogdom in the United States. They may be uniform gray, brown, greenish or reddish on the back with a dark vitta from the eye backward as a stripe of variable length. This is set off by a light area below the eye extending backward to the shoulder. There may be a dark triangle between the eyes with a stripe extending down the mid-back and a stripe on either side of this. These little frogs are so tiny, so delicate, that it does not seem possible that they are adult frogs. Their form is slender, their legs long, their eyes bright and bead-like, their snouts very pointed and extending beyond the lower jaw. The nostrils are on the sides of the pointed snout. These little midgets can turn their heads or tip them upward or sideways without turning the body.

Structure: Midgets in size; snout pointed and projecting beyond the lower jaw; nostrils on sides of snout; slender in form, hind legs very long; eyes bright and bead-like; disks on fingers and toes small but distinct; skin of back covered with very fine warts.

Voice: The call is a high, shrill, cricket-like chirp or trill.

Breeding: They breed from January to September. The brown and cream eggs are single, laid on bottom of ponds and in vegetation in shallow water and about 100 in number. The egg is $1/40$ - $1/30$ inch (0.6-0.8 mm.), the single envelope $1/20$ - $1/12$ inch (1.2-2 mm.). The greenish tadpole is small, $15/16$ inch (23 mm.), its tail long and its tooth ridges $2/3$. After a tadpole period of 45 to 70 days, they transform, June 30 to August 18, at $5/16$ - $3/8$ inch (7-9 mm.).

Notes: May 20, 1921. Okefinokee Swamp, Ga. We went down to the pond east of the negro quarters and it sounded as if bedlam had broken loose. I heard a cricket-like note everywhere. . . . One frog was on a grassy mat, one on a log, another calling from pine brush at the edge of the water, another on the bole of a tree. . . . Its throat pouch was transparent and we could see through it and discern the bark behind. . . . The croaks were 30-65 per minute. . . . It is surely a loud piercing call for so little a mite of frog flesh. It is an amusing little creature as it squeezes its slender body and throws out its large sac one half the size of the body.



Ornate Chorus Frog. Ornate Tree Frog.

Ornate Swamp Frog.

PLATE XXXIV. ($\times 1$). 1-4.
Females.

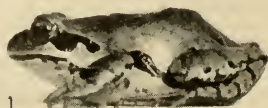
Pseudacris ornata (Holbrook).

Range: North Carolina, (B. B. Brandt, 1933) to Georgia, Florida and possibly west along the Gulf to Louisiana.

Habitat: Holbrook wrote of its habits, "It seems to resemble very much those of the *Rana sylvatica*. I have always found it on land and in dry places, and frequently in cornfields after light summer showers. It is very lively and active, making immense leaps when pursued, and consequently is taken with great difficulty." "The structure of this species indicates terrestrial, possibly subterranean habits. I have dug specimens out of the sweet potato hills in my garden." (Deckert, 1915). M. J. Allen found it breeding in grass-land pools.

Size: Adults, 1-1 2/5 inches. (Males, 25-35 mm. Females, 28-36 mm.).

General appearance: This is a large *Pseudacris*, looking almost like a small *Rana sylvatica*. The general color of this frog is chestnut brown with two indistinct darker dorsal bars and an indistinct darker spot between the eyes. There is a prominent dark al-



most black vitta from tip of snout through eye over tympanum, usually beyond the arm insertion, often extending half way to the groin. Two frogs with stripes of the back more prominent have a Y shaped triangle between the eyes, the other four do not show it. The groin spots are inclined to be almost black oblique bars, with light outlines. In fact, the spots on groin are on a yellow background. The tiniest rim of the upper jaw is dark, but above this is a conspicuous light line extending to the arm insertion and broadest under the eye. On the front of the upper arm is a dark bar. The eyes are very prominent with the upper part of the iris a bright gold band. The throat of the male is dark olive, with a central longitudinal plait. The throat of the female is light. The legs are barred.

Structure: Form more slender than *Pseudacris streckeri*; head narrower than *Pseudacris streckeri*; arms and legs longer and more slender than *P. streckeri*; fingers and toes long and slender, with mere trace of web at base of toes; snout pointed; nostril equidistant between snout and eye; vomerine teeth between nares.

Voice: "This call is very loud, similar in pitch to that of *Hyla pickeri*, but much shorter, and at a distance sounds like the ring of a steel chisel, when struck by a hammer. . . ." (Deckert, Copeia, July, 1915).

Norman Davis of Gainesville, Fla., says, "The call reminds me of *Hyla crucifer* but is without the trill."

Feb. 5, 1933. "I have timed *ornata* and found the calls to be repeated from 65-80 times a minute. I have never actually timed *crucifer*, but its calls are a good deal slower, probably 40-50 per minute. *Ornata's* call is a single sharply terminated note, while *crucifer's* is a more deliberate slur from a lower to a higher."—(Letter. A. F. Carr).

Breeding: Winter months. November, December, January to March depending upon the rains. H. K. Wallace and A. F. Carr, Jr., at Gainesville, Fla., secured eggs laid Feb. 5, 1933. They are brown and cream or white, and measure, the vitellus $1/25$ inch (0.9-1 mm.), the single loose envelope $1/7$ - $1/6$ inch (3.6-4.2 mm.). They transform at $5/8$ inch (14-16 mm.).

Notes: Color description of a female taken at Charleston, S. C., by E. B. Chamberlain, Nov. 4, 1932.

The background color of the back and top of head is Hay's russet becoming on side orange cinnamon or sayal brown. The two parallel dorsal bands are liver brown or carob brown, so also are the bars on the femur and tibia. Those on tarsus and foot merge into black. Snout stripe, eye vitta, lateral and groin spots are light cadmium or lemon yellow. The rear of the femur much as in the male. The light band along the upper jaw is very narrow and whitish. The upper jaw rim is bone brown. The eye is like that of the male. The venter is more or less like that of the male, except that the throat is white without discolor.

Strecker's Ornate Chorus Frog. Texas Ornate Chorus Frog.

PLATE XXXV. 1, 3, 4, 5, 6. Males ($\times 1$). 2. Male ($\times \frac{3}{4}$).

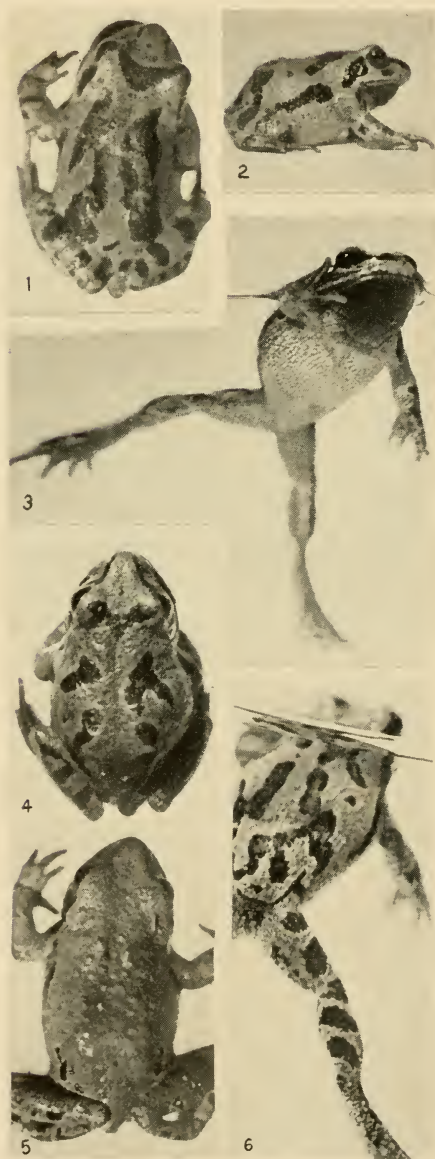
Pseudacris streckeri Wright and Wright.

Range: Texas, Oklahoma, Mississippi.

Habitat: Moist shady woods, grassy pastures, among grain stalks or in cotton fields. We found it breeding in a semi-swampy springy fork of a rocky branch of Helotes Creek in Texas.

Size: Adults, 1-1 $\frac{5}{8}$ inches. (Males, 25-41 mm. Females, 32-38 mm.).

General appearance: The head is short and wide; the body, short and "squatty." The fingers of hand are chubby, a toad-like hand. The toes are very slightly webbed, the disks slight. It varies in color from pale drab gray or pale smoke gray to hazel, brownish olive or pea green. Usually there are dorsal spots and frequently a triangle between the eyes. A dark line extends from the snout through the nostril and eye, over the tympanum to the arm insertion, sometimes continued as spots along the side. Dark cross bands are on the legs. The groin and front and rear of femur in males may be yellow or green or olive buff. The throat of male is dark. The tympanum is very small.



Structure: Head relatively wider; interorbital space wider; tongue rounded behind; vomerine teeth behind nares. When wiping off one male for photographing, we sensed that it had considerable secretion.

Voice: This call is rather shrill, somewhat like that of the common tree toad.

Breeding: They breed from December to late May. "Eggs in small bunches . . . attached to weeds and water grasses." (Strecker, 1926, p. 11).

Notes: Feb. 16, 1925, Helotes, Tex. We soon found three males calling, one on the bank, another amongst vegetation in water 3 or 4 inches deep, and another hanging to a branch at the water. We put these into a bag, and they began to croak. They had three or four diverse notes in the bag. These 'bag frogs' made others croak. We caught 5 or 6 in all, and do not believe the species at its height. . . . Air was 71 degrees at 7:30 p. m. when these were calling, the water, about the same. This afternoon was very humid.

On Feb. 10, 1932, we received 15 live adult *Pseudacris streckeri* (previously called *P. ornata* by Cope) from A. J. Kirn of Somerset, Texas.

At last, March 24, 1932, we have in hand at the same time live frogs of the so-called form *Pseudacris occidentalis* from Florida, and live frogs of the so-called form *Pseudacris ornata* from Texas. They are different forms. There is no doubt but what the form from Florida is the *Pseudacris ornata* of Holbrook and the form from Texas is no longer *P. ornata*. We call it *Pseudacris streckeri*. Several live frogs of each form put side by side reveal from superficial examination:

Pseudacris ornata from Florida is the more slender form—the snout is pointed, the arms and legs are longer and more slender—the fingers and toes are long and slender with a mere trace of web at base of toes. The indistinct darker marks on the back are bars. The nostril is equidistant between snout and eye, the dark bar on arm is long.

Pseudacris streckeri from Texas is a short fat squatty form, the snout is shorter and broader at the tip, the arms and legs are short and broad, the fingers are short and fat, giving the frog a toad-like hand. The dark vitta on the face usually ends in front of the arm insertion. The dark rim to the upper jaw is conspicuous. The light area is broad at the nostril and again back of eye. The dark pattern on the back is made of irregular spot-like bars, these frequently with a fork at upper end. The marks on legs are only partial bars, the spots are inclined to be lighter in the center and darker at the rim even when indistinctly outlined with light. The bar between the eyes may be a conspicuous V. The dark spot is at base of arm only, or slightly on the upper arm.

Anderson Tree-frog. Anderson's Tree Frog.

Anderson's *Hyla*. Anderson Tree Toad. Green and Yellow Tree-toad.

PLATE XXXVI. ($\times 1\frac{1}{4}$). 1-3. Males.

Hyla andersonii Baird.

Range: Central New Jersey (Middlesex Co.) to South Carolina.

Habitat: White cedar swamps. We found larvae in several pools, grassy, sedgy, sphagnaceous, along a dense woody border below one of the lakes at Lakehurst, N. J.

Size: Adults, $1\frac{1}{5}$ – $1\frac{7}{8}$ inches. (Males, 30–41 mm. Females, 38–47 mm.).

General appearance: This is a small green tree frog. The light bordered plum colored band along the side of the body with its yellow spots below gives this beautiful little frog its distinctive character. This band marks its green dorsal color very sharply from its white ventral parts. It has orange in axilla, groin and on the rear of the femur. The throat of the female has a white bordered green patch on either side. In its stout body, it differs from the more slender and larger *Hyla cinerea*.

Structure: Form stout, head broad and flat; skin smooth; posterior surface of femur spotted; vocal sacs, subgular.

Voice: This frog calls *aquack-aquack-aquack*, many



times, perhaps 20, at infrequent and irregular intervals.

Breeding: They breed from May 1 to July 20. The eggs are single, attached to sphagnum or on the bottom. The egg is $1/20$ – $1/16$ inch (1.2–1.4 mm.), the inner envelope $1/12$ inch (1.9–2 mm.), the outer $1/8$ – $1/6$ inch (3.5–4.0 mm.). The olive tadpole is small, $1\frac{2}{5}$ inches (35 mm.), its tail medium long with tip acuminate. The tooth ridges are $2/3$. After a tadpole period of 50 to 75 days, they transform from the end of June to September 1 at $7/16$ – $3/5$ inch (11–15 mm.).

Notes: "When the tail is nearly absorbed and they leave the water, they are about 25 mm. long and of a dull olive green. They grow lighter, that is brighter green in hue with the disappearance of the tail, until the little frogs, which in length of body are 15 mm., resemble the mature individuals. The white that margins the green of the back and extremities is not so conspicuous as in the adults, and the saffron of the underparts is wanting in those that I have examined." (Davis, 1907, p. 50).

June 16–28, 1928. "To the writer the call seemed a nasal 'quack,' almost verging on a 'quank' but without the strong 'n' sound of the latter. The call was never disyllabic.

"The note is repeated at about half-second intervals for sometimes fully 30 seconds. When the frogs are in full song an interval of about two minutes intervenes between outbursts. We had no difficulty in starting the frogs calling again at distances of from fifty to three feet, after they had been silent for a minute or so. One individual was recorded as having called 74 times in one period of song.

"The frogs definitely associate together for singing, whether because of the presence of females or for companionship. Five such singing groups were definitely located. Of these the first contained seven individuals, the second contained three, the third contained eight, the fourth contained three and the fifth, which was just across an uncrossable creek, contained at least six.

"The time of singing was remarkably constant. On every night but one the chorus started between ten and fifteen minutes before sundown. On the one exception, a clear dry night with a bright moon, the first songs were not heard until twenty minutes after sundown.

"The carrying power of the song was excellent. A chorus was plainly heard as an entity over 800 paces away, with two patches of woods and a brushy swamp intervening. The wind was negligible. Individual voices were distinguishable 754 paces away down a straight road, with a light wind blowing from the observers toward the frogs." (A. B. Klots, 1930, p. 108–111).

Canyon Tree-toad. Canyon Tree Frog.

Desert Tree-toad. Cope's
Hyla. Arizona Tree Frog.

PLATE XXXVII. ($\times \frac{4}{5}$).
1, 2, 4. Females. 3. Tadpole.

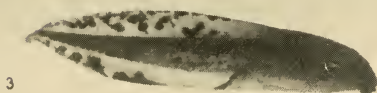
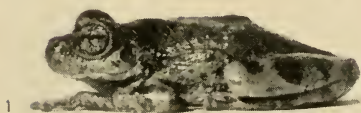
Hyla arenicolor Cope.

Range: South western United States, east to western Texas, south into Mexico, west into southwestern California, north into Utah.

Habitat: Rocky canyons.

Size: Adults, 1 $\frac{1}{6}$ –2 $\frac{1}{6}$ inches. (Males, 29–53 mm. Females, 30–54 mm.).

General appearance: This tree-toad averages smaller in size and duller in color than our common tree toad (*Hyla versicolor*). This tree toad when sitting quietly looks surprisingly like the little spotted canyon toad (*Bufo punctatus*), but when it climbs, its conspicuously long legs and large disks on fingers and toes immediately show it to be a tree toad. It easily clings to a vertical surface and climbs up even a sheet of glass. The back is brown or grayish in color with dark dots scattered over it. The legs are barred with dark areas. There is much yellow or orange on the rear of the legs, in the groin and in the axilla. It is light beneath. The skin is slightly rough, becoming more so as it becomes dry. Unlike the Pacific tree frog (*Hyla regilla*), this species has no stripe through the eye and along the side of the body.



The skin is roughened in *H. arenicolor*, smooth in *H. regilla*. This frog has slight webs between the fingers.

Structure: Long arms and legs with large disks on tips of fingers and toes; slight webs between the fingers; skin somewhat roughened; more or less uniform in color; tympanum small; prominent fold across breast; prominent fold on tarsus.

Voice: This call has been described as the "quack of a duck" by Storer; and as the "bleat of a goat" by Duges. To us, the note sounded lower, much weaker and less blatant than that of *Hyla versicolor* and not so persistent.

Breeding: They breed from March 1 to July 1. The eggs are single, floating near the surface or on the bottom of the pool usually attached to leaves. (Atsatt and Storer). The tadpole is medium, 2 inches (50 mm.), dark olive in color with some tail crests suffused with reddish orange pink to coral red. The tooth ridges are $2/3$. After a tadpole period of 40 to 75 days, they transform from June 1 to August 15, at $3/5$ inch (14-16 mm.).

Notes: July 16, 1917. Pinaleno Mts., Ariz. On the rocks over the water, Anna put her hand accidentally on a *Hyla arenicolor* and Ray Shannon found another on a tree trunk about four feet up. Paul Needham found another on a boulder just over the water. They do not seem at home in the swifter water.

July 5, 1925. Fern Canyon (near Alpine, Tex.). In the ravine just after a drenching rain, we found four transformed *Hyla arenicolor* on the boulders some twenty-five or more feet above the level of the creek. The creek was full of them before the rain. Today, July 6, the creek is down and clear. Near the falls we often found one or two *Hyla arenicolor* tadpoles amongst the boulders in shallow water or swimming at the surface. We secured today only one mature tadpole. The rest were small tadpoles. At the pool below the falls were many of them. . . . Also some above the falls.

July 7, Ranger Canyon. About 6:45-7 p. m., we arrived at the big pool or falls of east Ranger Canyon. Mr. L. T. Murray espied a frog in amongst the rocks in our very midst. It was an adult female *Hyla arenicolor*.

Viosca's Tree Frog. Whistling Tree Frog.

Bird-voiced *Hyla*.

PLATE XXXVIII. ($\times 1\frac{1}{4}$).
1-4. Males.

Hyla avivoca Viosca.

Range: Southeast Louisiana (Florida Parishes of Louisiana) to Florida. (O. C. Van Hyning, 1930). Georgia. (F. Harper, 1932).

Habitat: Tupelo swamps in the valleys of rivers and smaller streams on tupelo or cypress trees and on button-bush. (Adapted from Viosca, 1928).

Size: Adults, $1\frac{1}{8}$ - $1\frac{3}{4}$ inches. (Males, 28-39 mm. Females, 32-44 mm.).

General appearance: These frogs are a small edition of our common tree toad, *Hyla v. versicolor*. They may be brown or green or gray, light or dark. The arms and legs are distinctly barred. There is the characteristic light yellow or white spot below the eye. The color in the groin and on the rear of the legs is a pale yellowish green, instead of orange as in *Hyla v. versicolor* males. The throats of these males are more or less darkened with black specks. The dark pattern on the back consists of a bar across the head and the eyelids and an irregular area on the back, the bulk of the pattern being near the rump. The skin is moderately smooth, in some being very



finely granular. In appearance they are more slender than *H. versicolor*, and when dark brown as we first saw them they reminded us strongly of *Hyla femoralis*.

Structure: More slender than *Hyla versicolor*; muzzle truncate; webs large, but leaving the last two joints of fourth toe free, except for web margin; back almost smooth; ventral surface with distinct granulations; usually with narrow waist; male with folds on rear of throat almost to pectoral region.

Voice: "The voice is bird-like, being a plaintive whistle repeated in quick succession, much as in the red-bellied woodpecker. This call is sometimes preceded by a few notes of a slower call much like the voice of *Hyla crucifer*." (Viosca, 1928, p. 90). The swollen throat vibrates for 6-10 or 12 calls.

Breeding: They breed from June to mid-August. The eggs and tadpoles are not described. "*Hyla avivoca* is more clearly related to *Hyla versicolor* than to any other North American *Hyla*. . . ."

Notes: "The pitch and tone of the voice of *avivoca* is nearer to that of *crucifer* than to any other eastern American *Hyla* although its rate is far more rapid than that of *crucifer*." (Viosca, 1928, p. 91).

June, 1930. I mistook the first calls I heard for those of the Pileated Woodpecker.

June 11, 1930. Tick Faw River, La. (near Ferry). In Tick Faw River we heard a few *H. avivoca*. Finally Chase called me to hurry and started off on the run. I followed. We were soon in a tupelo swamp. Near the edge we heard them. Chase found his first one crosswise of leaves of buttonbush (*Cephalanthus occidentalis*). My first was on the bole of a gum. Many of Chase's captures were head down on upright branch of buttonbush. Mine were head up. Chase and I followed voices. We got five frogs between us. Viosca with a lamp on his head shone their eyes. He didn't follow voices so much. He got more in this way than either of us. One frog was pure green with no markings. Viosca found several on small gums near the tupelo edge while Chase's and my captures were farther in the swamp. On the trees was some poison ivy. On clumps or tree bases in the swamp and at the edge of the swamp were sensitive fern (*Onoclea sensibilis*), royal fern (*Osmunda regalis*), *Utricularia* (purple), a marsh St. John's Wort, sphagnum, water penny (*Hydrocotyle*), lizard's tail (*Saururus*), *Nyssa aquatica* and button bushes with mayhaws. Most of the frogs were 3 or 4 feet above the water. Finally Chase found a female on a log, in the water. Sometimes they go higher in trees. Usually they are down at 3-4 feet or less. Their call is bird-like. It is a fine delicate little species. Viosca did right to call it a new form, *H. avivoca*.

Mexican Tree Frog. Van Vliet's Frog.

PLATE XXXIX. ($\times \frac{2}{3}$). 1. Female. 2-7. Males.

Hyla baudinii baudinii
(Dumeril and Bibron).

Range: South-central and southern Texas through Central America.

Habitat: June 18, 1930. At 10 p. m., two miles west of Brownsville, in a resaca, found these frogs in small bushes, in weedy clumps, and even grassy tangles in overflowed tomato field adjoining the overflowed resaca. Later, along Rio Grande in Brownsville, found them in a pond. Mr. Blanchard tells me he saw Mr. Camp take them along the river (Rio Grande) in palms just above Mr. Rebb's palm grove.

June 19. . . Heard several in the palm grove which is completely flooded by high river. Beyond grove, and along river, a large chorus is calling.

Size: Adults, 1 $\frac{3}{4}$ -3 $\frac{3}{5}$ inches. (Males, 44-71 mm. Females, 44-89 mm.).

General appearance: This large tree frog has a black patch over the arm insertion and a white line encircling the arm insertion. Its color ranges from nearly black to light yellow green, gray or fawn. It has a transverse bar between the eyes with an oblique bar extending caudad from either end to unite with



a large dorsal spot with two forks. Various irregular lateral spots of black form a reticulation on a yellow or olivine side area. There are transverse bars on the legs, a light greenish spot under the eye, a light line above the dark edged upper jaw, and a dark line from eye to shoulder ending in a prominent black patch. The breast and throat may be spotted with dark. The posterior surface of thighs has spots. The sides are yellow posteriorly. In the female, the under parts of the throat and upper breast are white, the lower breast and belly white suffused with pale green. In the male, under parts are cream buff with lateral throat sacs, a pale brownish drab. The rear of the femur is yellow and russet, the underside of the hind legs is onion skin pink with yellow crowned tubercles.

Structure: Skin, smooth above, set with fine tubercles; under parts granular; tympanum nearly as large as eye; fold of skin from eye to shoulder; prominent fold across breast; disks large, fingers slightly webbed, toes webbed; a distinct tarsal fold.

Voice: The vocal sac is better developed on either side of throat than in its middle. The note is a burred *keck*, repeated 5-12 times, followed by a chuckle. These repeated *kecks* may last 2 or 3 seconds.

Breeding: The only record on transformation is of one specimen transformed, or just past, from Panama, 7/8 inch (21 mm.) in length, which was caught February 19, 1911. They were in full chorus in Brownsville, Texas, June 19, 1930. In Southern Vera Cruz, A. G. Ruthven found this species common. He observed them breeding on July 17. In 1908, near Cordoba, Vera Cruz, Dr. H. Gadow found a spawning congress of 45,000 frogs. His account is very vivid.

Notes: June 18, 1930. Brownsville, Tex. I went out the Military Road two or three miles where the road comes opposite a resaca which is 1/2 to 3/4 mile from the road. From the road, I heard a chorus new to me. My guess was *H. baudinii*. Pell mell I started, plowing through tomato, corn, and cane fields. . . . On little bushes or amongst tomato vines I heard these new frogs. . . . The first frog I never could locate, though I was almost on it in a tangle of grass and vines. Finally I located one in a bush where the water was waist deep. It was on a branch one foot above the water. This one was yellow-green. Then followed another. It was brown in color and on the ground where the water was shallow. I tried for several more. Whenever I approached, they stopped. In a pond beside the river in Brownsville I heard another *H. baudinii*. It was deep green on the back. None except the brown one had markings on the back revealed. The last one was found on the surface of the water amongst a clump of weeds.

August 22, 1930. Went over to Mrs. Olive Wiley's museum in the Minneapolis Public Library. . . . She had a beautiful *Hyla baudinii* from Central America. It came on a bunch of bananas to a local merchant.

Green Tree Frog. Carolina Tree Frog.



1



2



3

Cinereous Frog. Bell Frog. Fried Bacon Frog. Cow-bell Frog. Bull Frog. Cinereous Frog. Hallowell's Tree Frog. Carolina Hyla. Banded Hyla (*semi-fasciata*). Carolina Tree Toad.

PLATE XL. ($\times \frac{7}{8}$). 1, 3. Females. 2. Male.

Hyla cinerea cinerea (Schneider).

Range: Virginia to Texas, up Mississippi river to Illinois.

Habitat: Swampy edges of water courses; on the taller water plants in ditches or pools; on lily pads, on trees, bushes or vines not far from water. Prof. E. A. Andrews in 1928 reports finding them in pitcher plant trumpets.

Size: Adults, 1 $1\frac{1}{2}$ –2 $1\frac{1}{2}$ inches. (Males, 37–59 mm. Females, 41–63 mm.).

General appearance: This is a very slim, smooth, bright green tree frog with a light side stripe, pointed head and shallow face. It is relatively the longest legged *Hyla* of the east. Often there are small gold or yellow spots on the back. The under surfaces are white or yellowish white.

Structure: Slender, flat in body; skin smooth or minutely granular; breast fold present; vocal sac a round subgular pouch; a tympanic

fold from tympanum to base of arm.

Voice: The voice is loud and at a distance sounds like a cow-bell. The individual call is *quonk, quonk, quonk, quank*. To some ears, *fried bacon, fried bacon*. To Deckert, *grab, grab, grabit, grabit*.

At Flatwood, Ala., 1917, after 6:30 p. m. in a drying-up swampy pond, we heard a chorus which sounded like cow-bells at a distance. To one member of the party, it sounded like an exhaust running into an oil well pipe. We took one with the aid of a flash light. . . . It was on some bushes and its sides and throat looked like a pink ball.

Breeding: They breed from April 15 to August 15. The black or brownish and white or cream eggs are in small packets or films at or near the surface attached to floating vegetation. The outer envelope is poorly defined, becoming part of the mass. The egg is $1/30$ – $1/16$ inch (0.8–1.6 mm.), the inner envelope $1/12$ – $1/8$ inch (2.2–3.4 mm.), the outer envelope $1/8$ – $1/6$ inch (3.6–4 mm.). The tadpole is medium, $1\frac{3}{5}$ inches (40 mm.), its tail long and acuminate, its body green with a sulphur or ivory stripe on the side of the head from snout to eye. The tooth ridges are $2/3$. After a tadpole period of 55 to 63 days, they transform from July 2 to October, at $1/2$ – $11/16$ inch (12–17 mm.).

Notes: The same conditions do not always produce the same coloration. In one case, we had many *Hyla cinerea* in a botany drum. All were light green except three; one of which was almost black, another olive green or dark green, and the third yellowish green.

At night many individuals are seen to be fairly covered with certain tiny insects that are common in the ground vegetation. Some that were collected proved to be harmless flies (*Oscinia longipes*). Their perching on the frogs is probably accidental.

June 14, 1930. Beeville, Texas. All of a sudden several *Hyla cinerea* began croaking around the pond. They were on nearby mesquite bushes or on small dead plants above the water.

June 15, 1930. Beeville, Texas. At night. *Acris* began first, soon to be joined by *R. pipiens*, then came *H. cinerea*, and finally one or two *Gastrophryne texensis*. . . . We caught several *H. cinerea*. In one mesquite or papilionaceous plant we found 2 males facing each other, and caught each by putting the light between my legs, and grabbing with each hand. *H. cinerea* were about 1 or 2 feet above the water. A beautiful brown garter snake (*Thamnophis eques*) was coursing around the pond, ostensibly for frogs.

June 17–21. Brownsville–San Benito, Tex. In various resacas were several choruses of *H. cinerea*.

Green Tree Frog. Miller's Tree Frog.

PLATE XLI. 1, 3. Males.
($\times 1\frac{1}{4}$). 2. Female ($\times 1$).

Hyla cinerea evittata
(Miller).

Range: Virginia to New Jersey.

Habitat: Breed in lily pools and reed beds of tidal marshes. At other times, they are found on bushes and small trees near the water.

Size: Adults, 1 $1\frac{1}{4}$ –1 $\frac{7}{8}$ inches. (Males, 36–47 mm. Females, 32–47 mm.).

General appearance: This slim, smooth, green frog is like *Hyla cinerea*, but without the light stripe on the sides, and legs. Upper parts are cosse or lettuce or oil green; the sides, dull green yellow; the sides of under jaw, bordered with green or green yellow. The under parts are white, ivory yellow or marguerite yellow, with purple vinaceous to brownish vinaceous on the front of the forearms, femur, the rear of the tibia, and more or less on the under side of the legs. The rear of arms, legs and hind feet are margined with white to marguerite yellow. Sometimes there are fine yellow spots on the back.

Structure: Broader head and deeper face than *Hyla cinerea*.



1



2



3

Voice: The call is harsh and reedy with a suggestion of the guinea-fowl call. It is very like *Hyla cinerea*.

Breeding: Similar to *H. cinerea*. The smallest young we have seen were $7/8$ -1 inch (22-24 mm.).

Peeper. Spring-peeper. Pickering's Tree



Frog. Pickering's Tree Toad. Pickering's Hyla. Pickering's Hyla. Peeping Frog. Piping Frog. Castanet Tree Frog. Piping Tree Frog. Pickering's Frog.

PLATE XLII. 1, 2, 3. Males ($\times 1$). 4. Eggs ($\times 1\frac{1}{4}$). 5. Female ($\times 1\frac{1}{4}$).

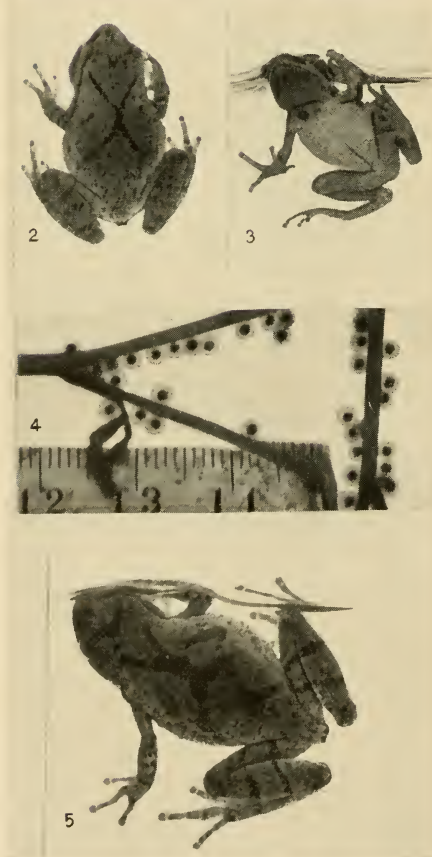
Hyla crucifer Wied.

Range: New Brunswick to Manitoba, south to Florida, Alabama, Mississippi, Louisiana, Arkansas and Kansas.

Habitat: They live in open lowland marshes, swamps at sources of streams whether wooded or open, sphagneous or cat-tail, in fact any pool, ditch, or shallow pond transient or permanent, grassy or muddy.

Size: Adults, $3\frac{3}{4}$ – $1\frac{1}{4}$ inches. (Males, 18–29 mm. Females, 20–33 mm.).

General appearance: This is a small frog with an oblique cross on the back. A male when first captured in early spring may be liver brown, chestnut brown, bay, claret brown or mars brown. The females are usually lighter in color. Both have obscure bands across the fore and hind limbs. The male has primrose yellow on the groin, throat olive ocher or aniline yellow in rear and citrine near the rim of the lower jaw.



The pectoral region is a pale yellow, and the rest of under parts, light vinaceous cinnamon.

Structure: Muzzle pointed, projecting considerably beyond the lower jaw; skin smooth or nearly so; fingers not webbed.

Voice: The call is shrill, clear, high pitched.

Breeding: They breed from April 1 to June 15. The eggs singly laid are submerged among fine grass or other plants in matted vegetation usually near the bottom of the pond, and are 800-1,000 in number. They are white or creamy and black or brownish in color, the jelly firm with well defined outline; the egg $1/25$ inch (0.9-1.1 mm.), the envelope $1/20$ - $1/12$ inch (1.2-2 mm.). The small tadpole, $1\ 1/3$ inches (33 mm.), has tooth ridges $2/2$ or $2/3$. After a tadpole period of 90 to 100 days, they transform from July 1 to Aug. 1, at $3/8$ - $9/16$ inch (9-14 mm.).

Notes: "Unless the day is overcast, or a warm rain is falling, little is to be heard from the frogs till about four o'clock in the afternoon when their concerts begin, to be continued in mild nights till morning. Considering the size, the volume of sound possible from one frog is surprising. As you approach a locality where they are in full voice, the air seems to grow gradually dense with this ear-deafening, all-pervading sound; occasionally the voices fall into a regular measure of time, but the effect is usually a medley of shrill sounds, a few voices audible above the others by reason of some peculiarity in key, or lack of smoothness in utterance. The piping of each individual is long continued; the interval between these musical efforts appears to depend on the mood of the musician." (Mary H. Hinckley, 1884, p. 314-315).

Apr. 7, 1929. Ringwood, Ithaca, N. Y. About 6 p. m. As it grew dusky, the din grew louder. Peepers seemed all around us, in ponds and on land, on ground and in bushes. The calls were everywhere, but to find one and see him call was a real job. We both looked for some time without success. Then we concentrated on a small pond. It was largely made up of tussocks of grass or sedge standing in water. The field grass at one edge was wet and "oozy". There was so much noise, it was hard to single out one note and locate it. The first we saw was down in the water, just at the surface, standing almost erect, sunken into the edge of a tussock, his back toward the water, the throat bubble toward the grass stems. He looked dark greenish brown or almost black like the dirty bases of the grass stem. If his bubble hadn't been vibrating, we never would have seen him. . . . Then we found a pair in a central tussock, the female looking much lighter, then another pair appeared at the edge of the "sopping" field grass. Several feet away from the pond, three feet up on a weed stem was a male calling lustily.

Sonora Hyla. Sonora Tree Frog.



PLATE XLIII. ($\times \frac{3}{4}$). 1, 3. Male with throat partly inflated. 2. Female in water. 4. Male in water.

Hyla eximia Baird.

Range: Texas, New Mexico, Arizona and Mexico.

Habitat: Edges of lakes, swampy and springy places.

Size: Adults, 1-1 $\frac{7}{8}$ inches. (Males, 24-43 mm. Females, 24-48 mm.).

General appearance: At first glance, these frogs look like Anderson's tree frogs (*Hyla andersonii*), green Pacific tree frogs (*Hyla regilla*), or large chorus frogs (*Pseudacris*). They are bright green with a dark purple or black line from the snout through the eye, broadening over the tympanum and extending half way along the sides. This vittal stripe may be broken into groin spots, is slightly margined above with white, on the sides is irregular in outline and may be lighter and bronzy in the center. There are two conspicuous linear black spots extending backward from the rump, occasionally paired dark spots on the forward part of the back, but no marks between the eyes. The groin is conspicuously greenish orange or old gold, as is the rear of the femur which is unspotted. There are irregular spots or bars on the tops of the arms

and legs. There are irregular dark borders on the upper and lower jaws ending in a dark spot at the shoulder. The throat of the male is dull greenish tan, that of the female white. Dr. Remington Kellogg in his Mexican series found a dark spot on each eyelid, but none of our frogs from Winslow, Arizona, had it.

Structure: Skin smooth above, granular below; a fold of skin across chest; a fold across the base of the throat in the female; fingers and toes with well developed disks; the fourth toe very long; fingers slightly webbed at the base; toes $1/3-1/2$ webbed; tympanum half the diameter of the eye; tibia half the length of the body; a tarsal fold present; inner metatarsal tubercle present, but outer metatarsal tubercle present, inconspicuous or absent.

Voice: The call is a low pitched, harsh, metallic clack. There is no trill in the call which consists of two to ten or twelve or more notes given in succession. These may be speeded up toward the end of the call. The vocal vesicle is very large, single and transparent with less yellow or green in it than is found in most tree toads.

Breeding: In United States, records indicate breeding from June to August. Two ripe females were taken at Santa Fe, New Mexico, June 18, 1874, by H. W. Henshaw. The deep olive and dull citrine tadpole is medium sized, $1\ 11/16$ inches (43 mm.), and has tooth ridges $2/3$. It transforms from July onward at $1/2-9/16$ inch ($13-13.5$ mm.).

Notes: "While at Mormon Lake, Arizona, on August 16 and 17, 1931, an interesting amphibian was found. A heavy rain came in the afternoon of August 16. After dark, frogs were heard calling near the lake shore, an interrupted chirp of a series of four to six notes often repeated. The maker of the call was found to be a *Hyla*, dull green above with brown spotting. Two males were collected on the first evening. The next day, while walking along the trail to the fire lookout tower, a female was taken. Another male was found near the top of Mormon Mountain. The species, which proved to be *Hyla eximia*, typically of Mexico, was found only on the ground, usually near the lake. Their occurrence so far from their reputed range seems worthy of note. Dr. Dunn has examined the specimens and confirmed their identification." (F. Willis King, 1932, p. 99).

On June 10 or 12, 1933, as Mr. W. L. Chapel, Jr., was starting for Arizona, we showed him illustrations of *Hyla eximia*. On July 6, he writes from Winslow, Arizona, somewhat as follows: "At present I am at Los Burros CCC camp near McNary. The last few days, we have had considerable rain. Toads are quite numerous about camp. Today we were working at Los Burros which is about six miles from Winslow. In a swampy place, I heard quite a chorus. I found endless numbers of green frogs. No other species could I find. I am sending these, eight of them . . ." On arrival, they proved to be four males and four females of *Hyla eximia*.

Pine Woods Tree Frog. Pine Woods Tree

Toad. Pine Tree Toad.
Pine Tree Frog. Scraper
Frog. Femoral Hyla.

PLATE XLIV. 1, 2. Males
calling ($\times \frac{1}{2}$). 3. Tadpole.
($\times 1\frac{1}{3}$). 4. Egg cluster ($\times 1$). 5.
Male ($\times 1\frac{1}{4}$). 6. Female ($\times 1$).
7. Female ($\times 1\frac{1}{4}$).

Hyla femoralis Latreille.

Range: Coastal region of
North Carolina to Florida to
Texas.

Habitat: Trees and shrubs
of pine barrens, breeding in
grassy transient pools at
roadside or in the woods, in
cypress ponds or bays or lily
covered swamp prairies.

Size: Adults, 1-1 $\frac{3}{5}$
inches. (Males, 24-37 mm.
Females, 23-40 mm.).

General appearance: This
frog is commonly a deep red-
dish brown in color, but may
be gray or greenish gray. It
resembles a small common
tree toad but is more slender
and the black markings do
not form a regular X. There
are orange or grayish white
spots on the rear of the
thighs. The under parts are
white. The throat may be
dark. The upper surface has
occasional granulations, the
under parts are areolate,
granulate on the throat, the
pectoral fold smooth, or
slightly granulate.

Structure: Muzzle rounded;
tympanic fold present; no
light spot under the eye; no



distinct light line along the jaw.

Voice: It is a peculiar cicada note in chorus, producing a continuous stridulating din which goes down the piney woods like a wave. The call in the trees is "*Kek*" at intervals, but near the water is speeded up to 6-7 a second, with 60-70 calls without deflation of the throat. In a large congress these calls can drown out even the shrill trill of *Bufo quercicus*, the little oak toad.

Breeding: They breed from April 20 to Sept. 1. The eggs are in groups of small films on the surface or just below it attached to grass blades or floating roots, the jelly loose and sticky, the eggs brown and yellowish, their size $1/30$ - $1/25$ inch (0.8-0.9 mm.), the inner envelope $1/16$ - $1/12$ inch (1.4-2 mm.), the outer envelope not distinct, $1/6$ - $1/3$ inch (4-6 or 8 mm.). The eggs hatch in 3 days. The tadpole is small, $1\frac{1}{3}$ inches (33 mm.), its tail tip acuminate, and free of spots, the lower musculature with a light stripe. Many have bright red in their tails. The tooth ridges are $2/3$. After a tadpole period of 50 to 75 days, they transform from June 16 to October, at $1\frac{1}{2}$ inch (13 mm.).

Notes: May 19, 1921. Okefinokee Swamp, Ga. On my way back from a trip to Crosby pond, at 6 p. m. near the remains of an old cypress pond in piney woods, I saw a female *Hyla femoralis* hopping along into saw palmetto. It was as whitish gray as any *Hyla versicolor* I ever saw. The spot in the middle of back showed beautifully, as did also the spot between the eyes. I held it to look at it. It leaped away on the gray sand. I had a hard time seeing it, it matched the gray sand so well. In one minute since its capture, it had darkened considerably.

In denser cover 9 inches high with small saw palmetto and small bushes, I found a half grown *Hyla femoralis*. It was green on its back (very suggestive of *H. squirella*, which strangely enough we don't get here).

May 21. In the compartment of *Hyla femoralis*, most of specimens (including one little half grown one) green when captured, are Vanddyke brown or moss brown. The adults are not often green, but their transformed life frequently starts in a green livery.

A captive female in a jar, June 19, is pale light mouse gray on the back with no markings revealed.

On April 23, 1921, the boys found two on a rail fence at 2:30 p. m. The next day they brought three more from the same fence. On April 26, the boys found some more *Hyla femoralis* in the rain barrels along the railroad and near the company's woodpile. In a pine near camp about 15 or 20 feet up on the end fork of large branch is a *Hyla femoralis* male. It doubtless is the one we have heard ever since we have been here.

The Barker. Barking Frog. Coat Bet. Florida

Tree Frog. Georgia Tree Frog. Florida Hyla.

PLATE XLV. 1, 7. Males ($\times \frac{2}{3}$). 2. Male croaking ($\times \frac{1}{4}$). 3. Male in a cornfield at night ($\times \frac{1}{4}$). 4. Female ($\times \frac{1}{2}$). 5. Transforming frog ($\times \frac{7}{8}$). 6. Eggs ($\times \frac{2}{3}$).

Hyla gratiosa Le Conte.

Range: North Carolina (B. B. Brandt 1933) to Florida to Louisiana.

Habitat: Trees of hammocks, pine barrens and bays. Breeds in pine barren ponds and cypress ponds.

Size: Adults, 2-2 $\frac{3}{4}$ inches. (Males, 49-68 mm. Females, 50-68 mm.).

General appearance: This is our largest native tree frog, ashen gray, purplish or green in color. The skin is evenly granular, the back evenly covered with elliptical or round spots darker than the general color and encircled with black. These spots may be absent in some of the color phases this frog assumes. A light stripe extends along the sides, bordered below by a purplish brown one. There is some yellow on the sides in axilla of arm and in the groin. The under parts are creamy or pinkish white. The throat of the male is green or yellow with dark spots just back of the chin, while that of the female has the center throat light, and



the sides of throat and pectoral region sulphur yellow. The colored area of throat is encircled with white on the inner side. The spots on the side, chin, and rim of jaw are reddish brown.

Structure: A large tree-frog of heavy build; skin granulated; head broad and short; fingers webbed; large disks on fingers and toes; prominent fold on breast; skin has marked secretion giving strong persistent odor.

Voice: The call is woody, deep, a curious *tonk, tonk*, like someone pounding on a hollow, heavy barrel or hoghead. The call in the ponds is *Coat Bet*. The call from trees as it approaches water is a bark.

Breeding: They breed from March to August. The eggs are laid singly on the bottom of the pond. The single envelope $1/10$ – $1/5$ inch (2.3–5 mm.), is loose, glutinous, and indefinite in outline. The vitelline membrane appears as an inner envelope $1/16$ – $1/10$ inch (1.6–2.5 mm.) in diameter, the egg $1/25$ – $1/16$ inch (1–1.8 mm.). The greenish tadpole is medium, 2 inches (50 mm.), and is the largest Hylid tadpole of eastern U. S. The tail is long, its tip acuminate with a flagellum and the tooth ridges $2/3$. The tadpole period is 40 to 70 days. They transform from July to October, at $9/16$ – $4/5$ inch (14–20 mm.).

Notes: "The Florida tree toad is a handsome species. . . . It is not very plentiful anywhere, and rarely met with outside the breeding season. During the latter time it comes down out of the trees and small companies of from four to ten specimens, in widely scattered pools or 'bayous' attend to their breeding duties amid the 'loud calls of males.' The call can be heard for over a mile, and sounds like a large gong, or church bell, being of unusual depth, and very clear, with a second's interval between each dual note. The male while singing, floats in the water, the large vocal sac throwing the frog into a vertical position with each utterance." (Deckert, 1915, pp. 4, 5).

While we were in the Okefinokee Swamp, Georgia, we usually recorded this species as Barker, Barking Frog, or Coat Bets. The last refers to the normal note in the breeding pools, the others to a puzzle that perplexed us for two seasons. On July 15, 1921, on Chesser Is., we heard of Coat Bet frogs, so named from the sound of their breeding call. On July 16, during the morning, we heard a barking frog in the trees south of camp. That night in a nearby pond was an immense chorus of Coat Bets. In 1922, the barkers perplexed us even more.

Not until July 26 did we solve the puzzle. About three miles along the road from Chesser Island to Folkston we heard in the evening in a cypress pond to the right of the road, some *Hyla gratiosa* and beyond them, a barker or two. We went after the barker, and found one in a small gum 4–5 feet, possibly 6 feet up. It is *Hyla gratiosa*! I saw him do it. There were two more barkers besides the one I caught. Several *Hyla gratiosa* were in the water calling normally.

Pacific Tree-toad. Pacific Tree Frog.

Pacific *Hyla*. Wood-frog.
(Cooper).

PLATE XLVI. 1, 2, 6. Females ($\times 1$). 3, 4. Males ($\times \frac{3}{4}$). 5. Female ($\times \frac{3}{4}$).

Hyla regilla Baird and Girard.

Range: Vancouver Island and British Columbia to Lower California; east to Idaho, Utah, Nevada and Arizona.

Habitat: On the ground, especially about streams, springs, ponds, swamps, and other moist places.

Size: Adults, 1-1 $\frac{7}{8}$ inches. (Males, 25.5-48 mm. Females, 25-47 mm.).

General appearance: This small, delicate tree toad is somewhat smaller and more slender than the canyon tree toad, (*Hyla arenicolor*) which like this form has the rear of the thighs uniform, not spotted. This species reminds the authors of species of *Pseudacris*. The disks on the fingers and toes are larger, however. It is very variable in color, usually with stripes on the back and a triangle between the eyes, and also with a stripe along the side of the head.

One male is light brown in color with a dark brown V between the eyes and two rows of large dark spots on the back. It has a conspicuous greenish black line from



the nostril to the eye and from the eye through and beyond the tympanum. Then there is a broken line of dark spots to the groin. There is orange or yellow in the groin and on the rear of femur and on the foot. The arms, legs and feet are indistinctly barred with dark. The upper jaw is a beautiful light pinkish cream color. The throat of this one (male) is dark in color, greenish. In middle of the light belly is a broad, longitudinal bluish area.

Another male is bright green, with an indistinct triangle between the eyes and round dark spots on the back. The dark mask is bordered above by a light pinkish cream line and below by the light jaw. The throat is olive with some orange on the center rear portion. Orange yellow is conspicuous in the groin and on the rear of the femur.

Structure: Upper parts smooth, not warty as is the usual condition of *H. arenicolor*; prominent breast fold; tympanum round.

Voice: The call is *kreck-ek* in rapid sequence.

Breeding: They breed from early January to mid-May. The brown and yellowish eggs, in small, loose irregular masses are laid beneath or sometimes at the surface, attached to vegetation. The egg is 1/20 inch (1.3 mm.), the inner envelope 1/12 inch (2 mm.), the outer envelope 3/16-1/4 inch (4.7-6.7 mm.). The tadpole is medium 1 7/8 inches (46.6 mm.); full and deep-bodied, its tail tip acute or obtuse without a flagellum. It is dark brownish in color and the tooth ridges are 2/3. After a tadpole period of 50 to 80 days, they transform from May 15 to September 1, at 7/16-11/16 inch (11-17 mm.).

Notes: August 12, 1917. We camped at Jacumba, Calif., beside the Mexican border. . . . In a little side stream of the creek we found a series of *H. regilla* from tadpole to transformation. In the same place among the weeds of the moist area we took 6-10 adults very variable in color.

August 25, 1917. In Alta Meadows, we found no end of transformed *Hyla regilla*. In the bog-terraced pools were plenty of tadpoles and advanced stages of *Hyla regilla*. On the trail, R. C. Shannon found a full grown frog and the boys reported a large one from Alta Peak. The transformed frogs were in the meadow land.

August 20-22, 1925. Las Vegas, Nev. Tonapah Road. . . . We followed one tiny stream back into the field and returned with the trophies of the search: 6 *Rana onca*, 4 *Hyla regilla*, 1 *Bufo compactilis*. . . . In a broad springy area sedgy and shady, we picked up a *H. regilla*. In one very small sedgy area, we caught four, three of which had a triangle between the eyes and some dorsal stripes. A half grown one was green with no triangle and only the vitta back of the eyes. Later at the big springs, we caught one that looked very yellow with very indistinct pattern. . . . We caught several tadpoles.

Giant Tree Frog.

PLATE XLVII. ($\times \frac{3}{4}$). 1-3.
Females.

Hyla septentrionalis Boulenger.

Range: On Oct. 30, 1931 (Copeia, p. 140) Dr. T. Barbour places it as established at Key West, Florida. In 1914 (p. 347) he has it from New Providence, Andros Island, Rum Cay, Cuba, and Grand Cayman.

Size: Adults, 2 $\frac{3}{5}$ -5 $\frac{1}{5}$ inches (64-130 mm.).

General appearance: This is a large tree toad. The head is broad, the outline of the skull evident as the skin is united to the skull, canthus rostralis and nostrils very prominent. The top of the head is smooth, the eyelids and back roughened with large and fine tubercles. The most conspicuous characters are the very large disks on fingers and toes, those on the fingers being fully as large as the tympanum. The eyes are large and prominent, the iris with brilliant orange tints. The color, when the frog has been under cover, becomes a dull olive green, but in the light becomes citrine, turtle green or oil yellow, with indistinct dorsal spots of dull citrine or grayish olive. The legs are barred with the same. The rear of the femur is reticulated with the same. The throat is pale, buffy, and



slightly granular, the rest of the venter is conspicuously and roughly granular and dull yellow in color, with the under side of the femur a deeper yellow, and the axilla bright yellow with a wash of same along the sides. The tubercles under the joints of feet and hands are prominent and pointed.

"Male with two external vocal vesicles, each being situated near the angle of the mouth; during the breeding-season the inner side of the first finger covered with blackish rugosities. From snout to vent 75 millim." (Boulenger, 1882, pp. 368, 369).

Structure: Tongue subcircular; head broader than long in adults; casque emarginate behind; snout rounded, contained two times in head to tympanum; pollex rudiment not free projecting; disks conspicuous; no interocular bar; upper eyelid small; tympanum distinct, $1\frac{1}{2}$ - $\frac{3}{4}$ diameter of eye.

Notes: Our experience is limited to one live frog sent us the spring of 1932, and two specimens given us several years ago by Dr. T. Barbour.

In 1931, Dr. Barbour adds it to the fauna of the United States. Of this extension he speaks thus:

"Another Introduced Frog in North America.—Several years ago, on a damp May morning in Key West, after a heavy shower, I heard the unmistakable call of *Hyla septentrionalis*. This sound is like the jerky pulling of a rope through an uncoiled pulley and is very characteristic. I hurried on my journey and thought nothing more of the matter until my kind correspondent, Mr. A. G. Elbon, sent me a jar of amphibia taken at Key West but a few days ago. There were, to my surprise, three superb specimens of *Hyla septentrionalis* amongst the lot in the jar. . . .

"Mr. Elbon's letter follows. I had asked him what he knew about the occurrence of these frogs.

"I first met with *septentrionalis* here at Key West about three years ago. That was when I first came here to live. The old people here seem to remember these big frogs in their gutter pipes since they were children. I know of no one here with enough knowledge of natural history to give me any very dependable information.

"The only place I have found these frogs is in the pipes leading from the gutters to the cisterns.

"Last summer these and the smaller frogs were so numerous as to almost be a pest. I was forced to put a screen over the ends of an eight foot pipe leading from the down spout to a rain water tank and in so doing took twelve frogs from the pipe. Five of which were *septentrionalis*. This year frogs of all kinds are very scarce. I would call this big frog common here. I have found it feeding almost altogether on the smaller frogs. . . ."

Southern Tree Frog. Squirrel Tree Frog.



Southern Tree Toad.
Scraper Frog. Rain Frog.
Squirrel Tree Toad.
Squirrel Hyla. Squirrel
Frog. Tree Frog. House
Frog. Tree Toad.

PLATE XLVIII. ($\times 1$). 1.
Male croaking. 2, 3, 5. Males.
4. Female.

Hyla squirella Latreille.

Range: Virginia to Texas,
and north up the Mississippi
basin to Indiana.

Habitat: In and around
buildings; about wells; in
bushes, trees, or vines; in
fields and gardens. Breeds in
open ponds in the pine bar-
rens, or in shallow roadside
pools.

Size: Adults, $7/8$ – $1\ 1/2$
inches. (Males, 23–36 mm.
Females, 23–37 mm.).

General appearance: This
species is small, delicate, and
with smooth skin. The head
is short, eyes prominent with
black pupil and bronzy iris.
The back is green or brown-
ish in color with at least a
partial transverse bar be-
tween the eyes and with
white on the upper lip. Fre-
quently there are rounded
spots on the back. The rear
of femur is not spotted. There
is a light line below the eye
and over the shoulder. There
may be a light irregular line
along the side just above the
belly.

Structure: Form delicate; skin smooth; canthus rostralis well marked, but not sharply edged; throat of male raw sienna or yellow with light area of greenish on either side; vocal sac, a large hyaline subgular pouch.

Voice: This call is a harsh trill, regular, mostly continuous, 15 calls in 10 seconds, but not very loud. It could not be heard a few rods away. One gave 67 pumps in 45 seconds.

Breeding: They breed from April to August. The eggs, single on the bottom of shallow pools are brown above and cream below, with outline distinct and jelly firm. The egg is $1/30$ – $1/25$ inch (0.8–1.0 mm.), the inner envelope $1/20$ – $1/15$ inch (1.2–1.6 mm.), the outer, $1/16$ – $1/12$ inch (1.4–2 mm.). The egg-complement is 950. The citrine drab tadpole is small, $1\frac{1}{4}$ inches (32 mm.), its tail long, the tail tip acuminate with a flagellum. The tooth ridges are $2/3$. After a tadpole period of 40 to 50 days, they transform from June to September at $7/16$ inch (11–13 mm.).

Notes: July 3, 1922. Along the Folkston Road, Ga., in temporary pools and ditches with *Bufo terrestris* were plenty of *Hyla squirella*. There is more vibration in the call of *Hyla femoralis*. I could not hear the *Hyla squirella* a few rods away. The calls of *Hyla femoralis* and *Bufo quercicus* drown it out. *Hyla squirella* does sometimes croak from the water surface when sprawled on the water.

On August 11, 1922, at Camp Pinckney, Ga., 2–3 p. m., we heard several. At 8:30 we returned to Camp Pinckney. There were no end of *Hyla squirella*, countless males on the ground in a road filled with temporary pools, in water 1–3 inches deep. The vocal sac is hyaline, more or less inflated for some time. The call is not so fast as in *Hyla femoralis*, but swift nevertheless. Those in water were greenish, those at the edges of the pool or in the road, brownish. . . . We could find no females. Some males, though quite small, were croaking.

In general, this species calls even by day in rain or before an imminent rain.

Okefinokee Swamp, Georgia. On July 3, 1922, about 11:55 p. m., we were at Anna's pond. We heard the *Hyla squirella* at a distance between two distant houses. In the saw palmettos and the grass stools were many scrapers. We found one pair in the grass near the edge. Others were found in saw palmettos about the border of the pool. The same night, near Trader's Hill, we came to a grassy overflow pond. In a clump of bushes and saw palmetto were several *Hyla squirella*. In grassy stools in shallow water were others.

Common Tree Toad. Common Tree Frog.

Tree Toad. The Northern Tree Toad. Changeable Tree Toad. Chameleon Hyla. Chameleon Tree Frog.

PLATE XLIX. 1, 2, 6. Males ($\times \frac{4}{5}$). 3. Female ($\times \frac{4}{5}$). 4. Male croaking ($\times \frac{1}{2}$). 5. Eggs ($\times \frac{3}{4}$).

Hyla versicolor versicolor (Le Conte).

Range: Maine, southern Canada, west to Minnesota, south to the Gulf States (Texas and Arkansas in part only). (S. and B. Check List.)

Habitat: Trees; mossy or lichen covered stone fences; decaying fruit trees.

Size: Adults, 1 $\frac{1}{4}$ –2 $\frac{2}{5}$ inches. (Males, 32–51 mm. Females, 33–60 mm.).

General appearance: This frog varies in color from pale brown to ashy gray, to green; it has a granular skin, dark irregular star on upper part of the back, a black bar on the upper eyelid, black bordered green bars on the legs, a black bordered light spot below each eye. It might easily be taken for a stone or bit of bark with lichen on it. The rear of the femur has dark reticulations on orange. The groin, axilla, and under parts of hind limbs are orange.

Structure: Skin rough, warty; conspicuous disks on fingers and toes.



Voice: The call is a loud resonant trill, ending abruptly, ten or eleven calls in half a minute. About the middle of May, at Ithaca, they are in the chorus stage. In the evening, all over the University hill and the hills nearby, along the wooded ravines, in the thickety edges and woods of our marshes, we may stumble upon the noisy tree toads slowly approaching the nearest breeding place. In one instance their resort is a pond at the end of a long hedge. Here, at the breeding season, every evening and sometimes after a thunder shower by day, the males can be heard all along its length, slowly bound for the one objective pool, where some have already arrived.

Breeding: They breed from the end of April to August 11. The brown and cream or yellow eggs are laid in small scattered masses or packets of not more than 30 to 40 eggs on the surface of quiet pools, the packets loosely attached to vegetation. The egg is $1/25$ – $1/20$ inch (1.1–1.2 mm.), the outer envelope indistinct $1/6$ – $1/3$ inch (4–8 mm.) merging in the jelly mass, the inner envelope $1/16$ – $1/12$ inch (1.4–2 mm.). They hatch in 4 to 5 days. The tadpole is medium up to 2 inches (50 mm.), tail long, scarlet or orange vermilion with black blotches around the edges of the crests and with a long tip. The tooth ridges are $2/3$. After a tadpole period of 45 to 65 days, they transform from June 27 to August, at $1/2$ – $4/5$ inch (13–20 mm.).

Notes: Ithaca, N. Y. June 19, 1907. This evening at 8:45 p. m., I reached the Veterinary College pond. Tree toads were in chorus. In fifteen minutes I had captured twenty individuals (including a mated pair). I found them also in the grass near by, migrating to the pond, one in the road just west. Toads were singing here also.

I went out to Cross Roads pond. Here they were just as common. The log in the southwest corner had four perched on it. To show how tame and how dazed they were by the light, I stroked a croaking male with the lighted end of my "Ever-Ready," 91 times without his stirring. He croaked just the same. I could have repeated the operation. . . . In a tree on the north edge of the pond were four males, two on one limb facing each other.

June 21, 1907. Cross Roads pond—11 a. m. All around the pond were tree toad eggs. I staked out about six or seven areas of them. The packets, each an emission of eggs, may be 6–12 inches apart or only an inch or less. Sometimes from groups of eggs at more or less definite intervals one can determine the path of the pair. The eggs are almost invariably at the surface.

Cope's Tree Frog.

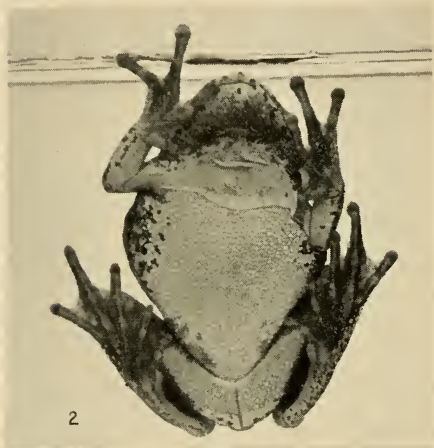
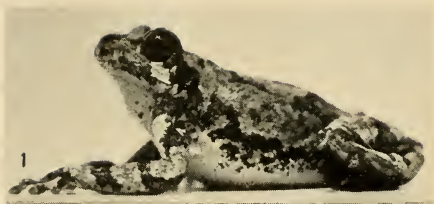


PLATE L. I. Female ($\times 1$).
2, 3. Males ($\times 1\frac{1}{5}$).

Hyla versicolor chrysoscelis
(Cope).

Range: Southern Arkansas
to east-central and southern
Texas.

Habitat: Wooded stretches
along creeks and rivers.

Size: Adults, 1 $2\frac{5}{8}$ –1 $7\frac{7}{8}$
inches. (Males, 36–43 mm.
Females, 35–48 mm.).

General appearance: These
frogs are a smooth skinned
version of our common tree
toad, *Hyla versicolor*. Of a
pair in hand, each has a light
spot below the eye, legs
barred and the irregular cross
on the back. The male at
present is a light grayish tan
with the pattern in green
outlined with black. The
female is gray with the pat-
tern in dark olive and black.
Both have the characteristic
orange on the groin and con-
cealed portions of the legs. In
these two there is no black
reticulation on the orange
rear of the femur. Often the
rear of the femur is marked
with very fine spots. The
dark mottling on the sides is
very distinct. The pattern of
the back is rather less massive
than in the average *Hyla*
versicolor. The male seems a
little smaller than the aver-
age *Hyla versicolor* male.
Sometimes the backs are
green.

Voice: It is a loud resonant trill.

Breeding: They breed from middle March to July. The tadpoles transform at 5/8 inch (16 mm.).

Notes: Cope's original description (*Hyla femoralis chrysoscelis*) is as follows: "*Hyla femoralis* Daudin. A specimen larger than the largest individuals I have previously seen; differs also in the greater extent of the palmation of the fingers, and in the coloration of the concealed surface of the femur. In eastern specimens the posterior face of the femur is brown, with rather small yellow spots; in this form it is yellow with a blackish coarse reticulation, which only extends to the lower surface of the proximal half of the thigh. The sides have a double row of small black spots, which enclose a yellow band. This is probably a subspecies and may be distinguished by the name of *chrysoscelis*. One specimen as large as a large *Hyla versicolor* was taken by Mr. Boll near Dallas." (E. D. Cope, 1880, p. 29).

March 24, 1925. Beeville, Texas. The air is resounding with *Pseudacris*. We heard a few scattering *Hyla versicolor* along the roadside ditches or in the distance and captured three males, but later lost one. They are along these roadside ditches but not in them. They look quite green at night. We captured one on the bole of a mesquite near the pond. Meadow frogs are croaking loudly in these ditches and narrow-mouthed toads are common.

June 14, 1930. Beeville, Texas. At night. We were about to leave the pond when we heard a *H. versicolor*. We started for it when we heard two more at a distance. One we caught. It has spotting on the rear of the femur, very fine spots down the outer half of the femur. When we reached the house we lost the *H. versicolor*.

June 22, 1930. We went out with R. D. Quillen. At Mud Creek, nine miles north of San Antonio, we heard many *Gastrophryne texensis*, *Rana pipiens*, a few *Bufo valliceps* and several *Hyla versicolor chrysoscelis*. We sought the tree toads. The first one was too high in the oaks. The next one we picked up on mud near the water. Then we heard a croaker near the spot but the one on the mud proved a ripe female. In another oak tree we found a male, three feet up. This we put with the female. When we returned to the house they were mated axillary fashion.

June 26, 1930. Waco, Texas. I saw some of Strecker's *H. v. chrysoscelis*. He pronounced my San Antonio live *Hyla versicolor*, *H. v. chrysoscelis*. These are smooth and quite greenish. In three *H. v. chrysoscelis* in the Baylor collection the suborbital spot is obscure or absent or present on one side and absent on the other. The femoral reticulation is more pronounced than in my *H. v. chrysoscelis* from San Antonio.

Dusky Tree Toad.

Hyla versicolor phaeocrypta (Cope).

Range: Specimens from Nashville, Tenn., Olive Branch, Ill., Mt. Carmel, Ill., Olney, Ill., Gull Lake, Brainerd, Minn. and Springfield, S. D. have been assigned to this form.

Habitat: River valley and lake shore.

Size: Adults, $1\frac{1}{3}$ – $1\frac{2}{5}$ inches. (Males, as large as 33 mm. Females, as large as 36 mm.).

General appearance: This is another of Cope's *H. versicolor*-*H. femoralis* puzzles based on preserved material. It is yet unsolved. Cope's original description follows:

"A single specimen of a strongly marked variety of this species was sent to the National Museum from Mt. Carmel, Ill., by Lucien M. Turner, (No. 12074). It is smaller, having the average dimensions of *H. femoralis*. The color is a dark brown, with three rows of large approximated darker brown spots. The groin and concealed faces of the thigh are yellowish brown, with a very scanty speckling of darker brown, very different from the usual coarse netted pattern. At first sight one suspects this to be a specimen of *Hyla femoralis*, but it possesses all the essential characters of the integument and feet of the *H. versicolor*, as pointed out in the analytical table of the genus, including also the light spot under the eye. It may be called *H. v. phaeocrypta*." (Cope, 1889, p. 375).

Notes: In hurried visits to three of its localities, we have not met this form. Live material from Wabash valley is our greatest need. Viosca now pronounces the type of *Hyla phaeocrypta* as a poorly preserved *Hyla versicolor*. What is this form?

Robber Frog. Barking Frog. Mexican Cliff Frog.

PLATE LI. 1, 3. After Brocchi ($\times \frac{2}{3}$). 2. After Brocchi ($\times 1$). 4. After Mocquard ($\times \frac{1}{2}$).

Eleutherodactylus augusti (Dugès).

Range: Jalisco to Southern Arizona.

"A frog of the genus *Eleutherodactylus* has been received from Mr. Sam Davidson, of Fort Worth, Texas. This specimen collected by Mr. Davidson October 1, 1927, in Madera Canyon, Santa Rita Mountains, Arizona. Miss Doris Cochran, of the United States National Museum, to whom this specimen was sent for examination and comparison, very kindly allowed Dr. Remington Kellogg to examine it, and it was referred by him, on account of the peculiar dorsal spotting, to *Eleutherodactylus augusti*, a Mexican species living in the state of Guanajuato, Mexico, rather than to *Eleutherodactylus latrans*, known only from the state of Texas." (Joseph R. Slevin, Copeia, Oct. 30, 1931, No. 3, p. 140).

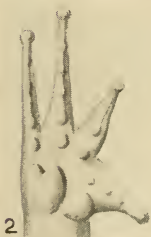
Habitat: (See Notes.)

Size: Adults, 2 $\frac{3}{5}$ -3 inches. (64.5-75 mm. [Kellogg]).

General appearance: "Mocquard concluded that *E. augusti* was identical with



1



2



3



4

Cope's *E. latrans* from central Texas. Direct comparison of Mexican specimens with the cotypes of *E. latrans* does not entirely confirm this assumption. Though there are no constant structural features that will distinguish specimens from these two areas, it was observed that in *E. latrans* the fourth toe is relatively longer, the color pattern consists of fairly closely aggregated large black blotches, the sides and hinder half of the abdomen are faintly areolate, and the skin on the upper parts of old adults is stiff, coarse, and areolate. These two forms are unquestionably rather closely related. An immature individual from Jalisco and an adult individual (with a body length of 75 mm.) collected by Ruthling, which unfortunately is without any definite locality, were used in these direct comparisons. The skin on the upper parts of the immature individual from Jalisco is much more tubercular and warty than that on the Texas specimens. Juvenile characters, such as vestigial postcephalic intratympanic dermal fold and vomerine teeth in minute clusters, are not unusual, but the presence of an abdominal disk seems rather remarkable for so young an individual." (R. Kellogg, 1932, p. 101).

Notes: "The *Hylodes augusti* (Dugès MS.), Brocchi Mission Scientifique de Mexique, 1881, from Guanajuato, Mexico, is related to the present animal. I do not know what the specific difference is, unless it be in the form of the vomerine patches, which I can not clearly make out from Brocchi's description." (Cope, 1889, p. 317).

We, in working over our material, concluded from Brocchi's and Mocquard's descriptions and from Mocquard's figure that *E. latrans* must be reduced to the synonymy of *E. augusti*. We had no access to the type specimens of the latter species. Independently, Dr. Remington Kellogg came to the same decision, but on a recent trip to Europe, he examined the types of *E. augusti* and assures us that *E. augusti* is distinct from *E. latrans*. Two or three specimens in Baylor University and San Antonio Museum (Marnock specimens) have a light transverse band across the back from forearm to forearm like Brocchi's figure and Kellogg's description. We are fearful that the question of the distinctness of *E. augusti* is not yet solved.

"*H. augusti* is essentially nocturnal which explains its rarity in collections. Cope was made acquainted with these habits from the information furnished him by M. G. W. Marnock who discovered it in Texas. These details confirm for me the following information well given by M. Diguët: 'These batrachians are encountered in the territory of Tepic in the humid ravines, at the beginning of the rainy season at the end of June and July. The voice is resounding and is heard at a great distance after the setting of the sun. At the time mentioned above, one finds them fastened on the trunks of certain trees with smooth bark such as the *Burseras*, the color of which is the same as that of the animal.'" (Mocquard, 1898-1899, pp. 160-163).

Barking Frog. Robber Frog. Texan Cliff

Frog.

PLATE LII. 1. Male ($\times \frac{1}{2}$).
2. Male ($\times \frac{2}{3}$). 3. Male ($\times \frac{1}{3}$).

Eleutherodactylus latrans
(Cope).

Range: Texas, Helotes and Waco. We had reports of it as far west as Devil's River, Texas.

Habitat: Limestone ledges of the cliffs that front the Edward's plateau. They have also been reported in caves.

Size: Adults, 1 $7/8$ –3 $3/5$ inches. (48–90 mm.).

General appearance: This is a large, short bodied squat frog with extremely powerful forearms and long outer fingers. Its fingers and toes have expanded tips and prominent tubercles on the under surfaces. It has two solar and two palmar tubercles. The head is wide and flat, the loreal region, oblique. The skin is smooth. In color, it is light purplish brown with darker spots. The back may be light drab or pale drab gray with brown spots. The middle of the throat and the under parts are pale pinkish buff.

Structure: Large, short bodied, squatty; extremely powerful forearms and long outer fingers, for climbing; male with forearm best developed, brachium little developed; two solar, two palmar tubercles; head wide and flat; skin smooth; muzzle



projects beyond lower jaw; vomerine teeth in two short raised patches between the inner nostrils; tympanum slightly deeper than wide; tongue slightly nicked behind; fold of skin from eye over tympanum almost to arm insertion; central abdomen surrounded by a circular fold of skin; disks transverse.

Voice: At a distance the call was certainly a bark, but as we climbed the hill and came near, it was more of a throaty whurr. It is ventriloquial to some degree, and the location of the calling frog back under the ledge doubtless increases the volume of sound.

Apr. 24, 1933. "Roy (R. D. Quillen) returned Sunday (23rd) from a trip in the Frio Canyon (Texas), and the barking frogs do bark. Mr. Fisher, on the ranch said that the frogs made so much barking four weeks ago that he was awakened nights. We hear them every evening when we sit on the front porch of the ranch house." Letter. Mrs. Ellen Schulz Quillen.

Breeding: Probably they breed during any rainy period from February to May. It is likely that the large eggs are laid in moist or rain-filled cracks or crevices or even caves in the rocky cliffs and ledges where they live. A specimen in the National Museum contains about 50 eggs each measuring $1/4-5/16$ inch (6-7.5 mm.) in diameter. The tadpole development is probably within the egg.

Notes: Feb. 20, 1925. Helotes, Texas. The instant I had it in hand it swelled up taut, bladder-like. When I reached the store, I realized I was sweating, and started to brush the sweat out of my left eye; it smarted afterwards. Some cuts on my hand did also. It affected the mucus of my mouth slightly. It certainly has a secretion.

Feb. 22. In photographing male *E. latrans*, it would wedge itself in the cell and climb right out of the jar. When I had it in hand, it bent the last joint of the two outer digits. These have expanded tips. With these bent digits, it can pull readily and strongly. It must use these for pulling itself along or preventing animals from pulling it out.

Mr. Marnock told Mr. Cope, "During the winter the adults are very noisy, the rocks resounding in the evening with their dog-like bark. The noise is supposed by the country people to be made by lizards, especially the *Gerrhonotus infernalis* which occurs in the same region." (Cope, 1878, p. 186).

In G. W. Marnock's collection, Baylor University, No. 2022 has a prominent transverse band across dorsum from arm insertion to arm insertion. Back of it comes a broad transverse area of olive buff outlined behind by two dark spots, one either side of the meson. This prominent light band has a median light dorsal stripe extending forward on meson to between the eyes. U. S. National Museum, No. 13,633 (G. W. Marnock, Helotes, Texas), which measures 48 mm., has an indication of this median line between the eyes, and possesses a quite spotted back.

Ricord's Frog. Cricket-toad.

PLATE LIII. 1-4, 6. Adults ($\times 1$). 5, 7. Embryo developing within the egg. No free tadpole ($\times 5$). 8. Larva freed from gelatinous envelope, 3 days older than fig. 7. 9. Female ($\times 1\frac{1}{4}$). (5-9. Drawings by R. F. Deckert.)

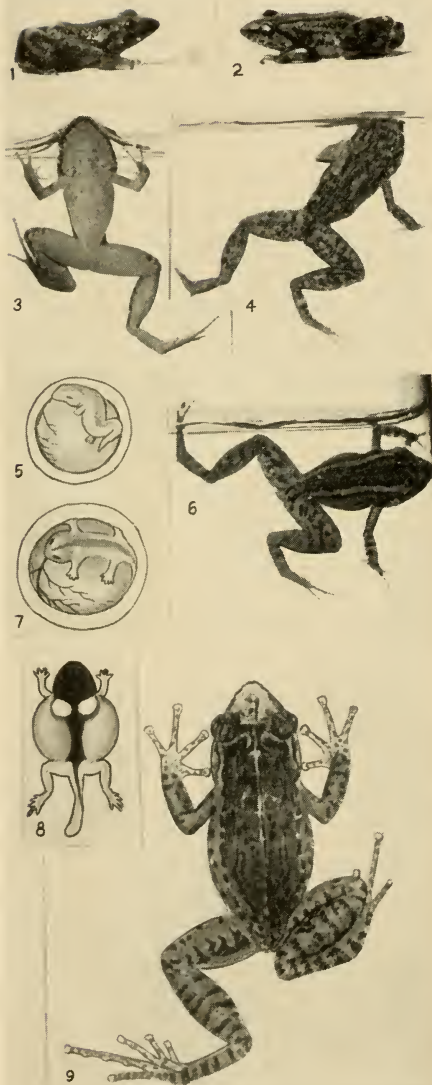
Eleutherodactylus ricordii (Duméril and Bibron).

Range: Bahama Islands, Cuba and Florida, north to Auburndale and Gainesville, Fla. It is spreading northward.

Habitat: Subtropical Florida. Entirely terrestrial. In the hammock or in dry pine barren lands under heaps of limestone where there would always be moisture.

Size: Adults, $3/5-1\ 1/5$ inches. (15-30 mm.).

General appearance: It is small, elongate, similar to *Syrrhophus marnockii* but possesses two long transverse curved series of vomerine teeth, behind the internal nares. These are delicate little frogs with the head as broad as any part of the body. The eyes are prominent, bead-like, bronzy and black. The snout is prominent, truncate, extending slightly beyond the lower jaw. The legs are long and slender. The fingers and toes are very slender with terminal disks, and prominent palettes at the joints of



fingers and toes, giving a sawtooth appearance in lateral aspect. The color pattern varies, but the coral pink snout is prominent in each of these individuals. The legs are coral or reddish, barred with fine olive bars. In one there are two prominent coral stripes along the sides of back, the mid-back being brownish olive. In the others, the coral on the sides appears as areas fitting into the scallops of the dorsal brownish olive band. The forward end of this dorsal bar forms a stripe across the head between the eyes: there is another dark stripe across the snout. The edges of the upper and lower jaws are prominently spotted with light and dark. There is a faint ridge of skin down the mid-back. The skin of the back is slightly roughened. The skin of belly and under side of hind legs is areolate. There is a prominent vein down mid-belly. The under parts are light in color, grayish on the underside of hind legs.

Structure: Subgular vocal sac; tympanum $1/2$ size of eye; tongue elongate oval, slightly nicked; heel reaches orbit or even snout; lower jaw with a median tubercle fitting into a median notch in upper jaw; two metacarpal and two metatarsal tubercles.

Voice: "Its twittering call can be heard from hammocks as well as dry pine land, after showers during April, May, June, July, and August." (Deckert, 1921, p. 22).

"Their chirping notes are a common sound after dark and on cloudy days." (O. C. Van Hyning, 1933, p. 4).

Breeding: They breed from April to August. Development goes on within the egg to adult form, there being no tadpole stage. The newly hatched young are $3/8$ – $1/2$ inch (9–11.5 mm.) in size.

Notes: "Ricord's Frog does not go to the rain-pools in numbers, as do the other Salientia. Pairing seems to take place on land during rainy weather, in dark places. The writer has so far failed to find specimens in copula, but on May 16 two batches of eggs, containing a dozen each, were found in a depression filled with dead leaves and leaf-mold in a 'hammock.'" (Deckert, 1921, p. 23).

"*Ricordii* lays 19–25 eggs in vegetable debris in woods. . . . yolk being about 2 mm. in diameter, and the outer envelope eventually reaches 4 mm. No trace of external gills could be made out in either species. . . . The night of July 28 a batch of 25 eggs was laid. I left Soledad on July 30 and returned on August 2 and found that a second batch of 19 eggs had been laid in my absence.

"The eggs of the 28th began to hatch August 7, making a period of eleven days. By August 11 all were out, making a period of ten days from the 2nd.

"On August 11, 1925, I found 21 eggs in a fallen Bromeliad. These hatched six days after (August 16) and as soon as the yolk was fully absorbed and the adult coloration assumed they were seen to be *ricordii*." (Dunn, 1926, p. 155).

White-lipped Frog. White-jawed Frog.

PLATE LIV. 1. After Brocchi ($\times \frac{3}{4}$). 2. After Boulenger ($\times \frac{3}{4}$). 3, 4. After Schmidt ($\times \frac{2}{3}$).

Leptodactylus albilabris (Günther).

Range: Vera Cruz to Nicaragua; also in Porto Rico and Virgin Islands. Recently Dr. E. H. Taylor and J. S. Wright took it near Rio Grande City, Texas. This adds to the problem of its queer distribution. In 1902 Dr. Stejneger knew no parallel of this distribution and suggested its accidental introduction into the islands by man, such as the wrecking of a cargo of logwood or mahogany many years ago. In 1914 Dr. Barbour discards the accidental agency of man and holds that "it is more probable that the Porto Rican and mainland individuals have by some fortuitous parallelism become indistinguishable if they originally belonged to different stocks, or if both were derived from the same stock then they have preserved their identity in parts of their range and varied with isolation in other parts." Dr. Noble in 1918 points out three characters of difference between mainland and insular forms but frankly admits no criterion is constant. K. P. Schmidt in 1928 calls the mainland and insular forms very close but is not able to



state that they are identical.

Habitat: Moist meadows, irrigated cane fields; drains, gutters, in towns; beneath stones and logs (Schmidt). Near streams and in marshy places; in burrows in sand banks and fields (Stejneger).

Size: Adults, 1 $2\frac{1}{5}$ –2 inches (35–49 mm.). Dr. Stejneger records one $5\frac{5}{8}$ inches (144 mm.).

General appearance: This smooth-skinned medium-sized frog has a dorsolateral fold and another below it on the side of the body. It has no disks. A cream-colored or pale straw yellow labial stripe, a dark vittal stripe from nostril to shoulder, and several rows of spots on dorsum (light-margined or not), are some of the diagnostic color characters. The general coloration of the dorsum may be olive, clay-color, reddish brown, olive green, olive yellow, or other colors. Some have a broad median stripe down the middle of the back.

Structure: Tympanum $1\frac{1}{2}$ – $2\frac{1}{3}$ the eye; vomerine teeth curved, slightly oblique, behind level of the nostrils; tongue slightly nicked posteriorly; nostrils nearer tip of snout than eye; first finger longer than second; second and fourth fingers equal; toes scarcely webbed; two metatarsal tubercles; slight tarsal fold; interarticular tubercles prominent; male with two vocal sacs, communicating with each other and each with a separate slit; heels overlapping when at right angles to the body. (Combined from Günther and Schmidt).

Voice: To Dr. Stejneger the voice is "fairly loud for its size. . . and can be expressed by the word '*pink*' in frequent succession."

To K. P. Schmidt "the chorus of this species is one of the most insistent notes heard in Porto Rico, both by day and by night. . . it is comparable in quality with that of the North American *Acris*. The interval between notes is variable but usually very short and regular. There is an occasional somewhat guttural trill. . . ."

Breeding: From early in the year to October 1, the eggs (75–200) are laid in a white foamy mass, which may be in an excavation beneath stones, or other cover in shallow water, or may be under stones, logs or cover near or away from the water. The latter masses may be washed by rains into the nearby stream or pools. The eggs are light yellow, $1\frac{1}{10}$ – $1\frac{1}{8}$ inch (2.5–3 mm.) in diameter. The largest tadpole of Dr. Stejneger's series measures $1\frac{7}{8}$ inches (46 mm.). The tadpole is dusky olive gray on the back, its venter white marbled and mottled with dusky, its anal tube long median, its tail crests low with edges parallel. The tooth ridges are $\frac{2}{3}$, and muciferous ducts are evident. Transformation is at $1\frac{1}{2}$ – $1\frac{11}{16}$ inch (13–17 mm.) during many months of the year. (After Stejneger and Schmidt).

Notes: Taylor and Wright found that their specimen had an indistinct dorsolateral fold, larger choanae, larger triangular bony prominences on which the vomerine teeth occur, dorsal coloration without spots, and was different in other respects.

Camp's Frog.

PLATE LV. ($\times 1\frac{1}{5}$). 1-8.
Adults.

Syrrophus campi Stejneger.

Range: Brownsville, Texas.
Lower Rio Grande valley.

Habitat: In moist earth
under board-pile, brick-pile,
stones or similar shelter.

Size: Adults, $\frac{5}{8}$ -1 inch
(15-25.5 mm.).

General appearance: This
form is very similar to *Syr-
rhopus marnockii*, and be-
longs to a Mexican genus. It
is a small delicate grayish
olive frog, with scattered
dark spots on the back, with
a dark band from the nostril
through the eye at least to
the tympanum, and with
dark crossbars on the legs.
The skin is finely granular.
The nose is pointed. The for-
ward portion of the under
parts is a pale yellow green.

Structure: Small, delicate,
flat in body; a blood vessel
visible down the middle of
the belly; fingers and toes
long and slender with promi-
nent tubercles which viewed
from the side appear saw-
toothed; forearms well de-
veloped; tips of fingers ex-
panded and truncate, toes less
so; at least one light colored
tubercle just back of angle of
mouth, and near the lower rear
margin of the tympanum;
often a collection of tubercles
in this region or an oblique
row to the arm insertion.



Voice: This frog gives a cricket-like chirp, but with a whistle. It is not a continued call, but often consists of only one or two notes which can be heard a few yards away.

June, 1930. Brownsville. The note may be one *tick* or two or three *ticks*, well measured, or two may be rapid and close together. Some times after these, comes a cricket-like call.

Breeding: They breed from April to May. The eggs are few, 6-12, and very large, the egg yolks about $1/8$ inch (3-3.5 mm.). Larval development is probably within the egg. The smallest frogs we have seen in collections range $1/5$ - $5/16$ inch (5-8.5 mm.).

Notes: April 27, 1925. Brownsville, Texas. Mr. Camp took me to the type locality. It was in a small back yard of a private residence in the center of the city. In the rear of the house was a laundry room the floor of which was close to the ground. Against the rear of the house were two small piles of brick, each of which was no more than 2-3 feet across and $1\ 1/2$ -2 feet high. The ground was moderately moist there. Mr. Camp said, "Move these bricks and you will find them, but grab quickly." I was not quick enough for the first one. The associates of these frogs are sow-bugs, ants, snails and spiders. Something jumped into a hole, all I got was the impression of the jump. . . . I saw 12 or 15, but all I captured were four adults. Only a keen collector would have discovered this new species.

April 28, 1925. We visited the board-pile habitat. Under boards and bricks near the edge we found several. . . . Under one board a foot square, we found four at edge of the pile. It certainly seems as if they come out to the edge of board-pile at dusk or in the evening.

June 17, 1930. About 9 p. m. after darkness came on, I walked about Brownsville and heard in many yards *S. campi*. They are a dooryard, or frontporch or garden friend, cheerful as a cricket. When we mounted a large plate of Camp's frog, we put in the type localities for fear the species might temporarily be lost. No danger. I heard them along the Rio Grande in the grassy localities, and also along railroad right of way. One must know how to collect them.

June 19, 1930. Mr. Rebb's palm grove. Arrived at 7 p. m. and found the Palm grove flooded. In the grove there are plenty of *S. campi* near its unflooded edges. Others sound as if in deeply flooded parts. Are they temporarily on boles of trees, on large fans or in a litter of palm leaves at the surface? Surely this species is not scarce. It is common.

Marnock's Frog.

PLATE LVI. ($\times 1$). 1-6.
Adults.

Syrrophus marnockii
Cope.

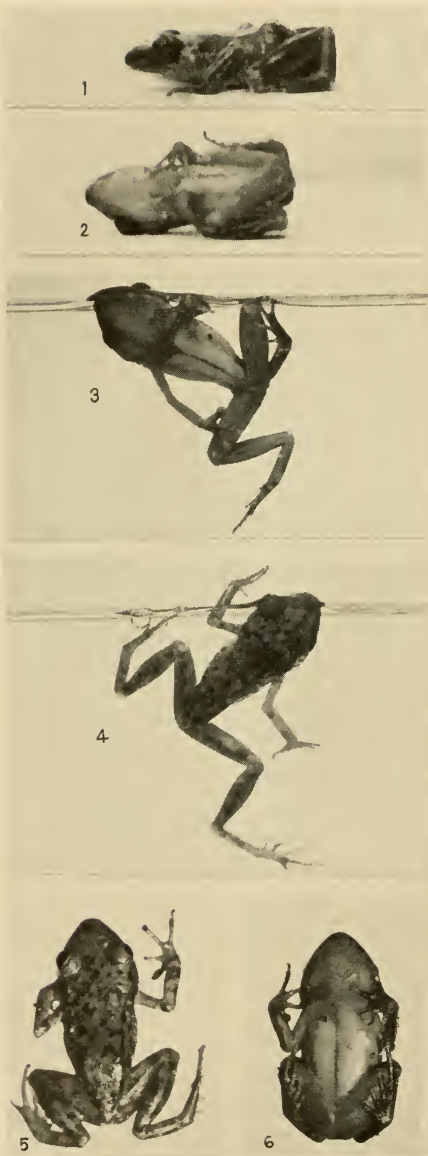
Range: Helotes near San Antonio, San Marcos and Austin, to Chisos Mts. (Drs. F. M. & H. T. Gaige) Texas.

Habitat: Cracks, crevices, caves in limestone ledges of the hills and ravines. We made our captures under large flat stones near limestone ledges, one above the wall of a ravine.

Size: Adults, $7/8-1 \frac{3}{5}$ inches (22-39.5 mm.).

General appearance: This small, flattened frog has a long flat head, with a broad space between the eyes, which are large and prominent, indicating nocturnal activity. In general color, the back is greenish, spotted with brown, the under parts, light-brownish vinaceous, the legs cross-barred. The nostril is far in front of the eyes, which are as far apart as the breadth of the hump. The skin is smooth. There are one or two white or deep colonial buff tubercles below and behind the tympanum.

Structure: Small flattened body; eyes prominent, widely separated by broad flat space; fingers and toes long and slender with prominent tubercles, which if viewed from the



side give the digits a prominent sawtoothed appearance; tips of fingers are expanded and truncate, toes less so.

Voice: This is a cricket-like chirp of one or two notes of an instant's duration, possibly followed by a trill of two or three notes.

Breeding: Development is probably within the egg and during April and May.

Notes: May 5, 1925. Helotes, Tex. In Helotes Creek Canyon above camp . . . where a side ravine comes in, we were searching for a poinsett's lizard we had seen. . . . About 3-4 feet farther up the side of the canyon was a large, flat, loose stone on a stony slope. I lifted it and a small frog hopped out. I got the impression of a greenish frog. I dropped the stone quickly to see where the leaping frog went and lost it. Then I lifted the stone again and at first my eye did not espy the second frog. Had it been a Camp's frog it would have leaped. Presently my eye saw a *Syrrhophus*. It is Marnock's frog. It is bigger than Camp's, but much like it.

Our second frog was caught May 10 on Marnock's hill, back of the store at 4 p. m. In the morning it rained hard until 1 p. m., then we went to Marnock's Hill. East of the store one-half mile, found on top of the hill a pebbly place with a few flat stones. A banded gecko and Marnock's frog were under a stone. It was moist, black dirt beneath the stone, and it was in a more or less open place with dwarf oaks about.

June 23, 1930, San Antonio. I left at 8 o'clock for Helotes with Gable and his son, Hugh. They parked their car at a crossing above G. W. Marnock's house. They started up a horseshoe hill I never was on in 1917 or 1925. I suspect this was Marnock's special hill for collecting. His house is in the opening of the horseshoe. After we reached the top, we went down toward a glen where there had been seepage, earlier. In this place they had found two Marnock's frogs which they gave to Mr. Parks to send to General Biological Supply. One of these very frogs we received this spring. Their habitat was much the same as those found by us.

In a recent letter (Feb. 9, 1930) Mr. Walter J. Williams incidentally speaks of it thus: "I was surprised to see that you did not ask for *Syrrhophus marnockii*. I found it rather common near San Marcos and if I were there for a time I believe I could get several specimens for you. I understand several have looked for it here since I left but no one else found it. It is best hunted at night."

Gopher-Frog. Snake Frog. Florida Gopher Frog. Southern Gopher Frog. Florida Frog.

PLATE LVII. 1, 5. Males ($\times \frac{2}{3}$). 2. Male. ($\times \frac{2}{5}$). 3. Male croaking ($\times \frac{1}{5}$). 4. Eggs ($\times 1$).

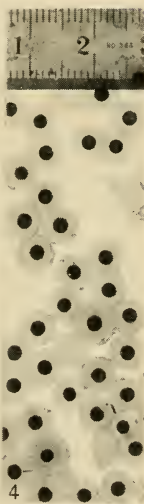
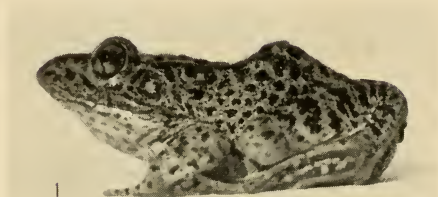
Rana aesopus (Cope).

Range: South Carolina to Florida and Louisiana.

Habitat: Almost solely in the borrows of the gopher turtle, which is common in the higher pine barrens and sandy hills. They breed in cypress and open ponds. We saw one go into a small opening which looked like a rat hole. The hole extended 18 inches into the ground and the end was only 9-12 inches below ground. There we found a female gopher frog. Near another turtle's burrow, we saw a similar hole with a smooth worn spot about 8-12 inches away, the resting place of the frog.

Size: Adults, 2 $\frac{3}{4}$ -4 $\frac{1}{3}$ inches. (Males, 68-101 mm. Females, 77-108 mm.).

General appearance: This large heavy-bodied gray frog, is broad forward and has a slender waist. It has a cavernous mouth and prominent eyes. The gray of the back is finely speckled with black dots and marked with three or four rows of round dark spots between and often crossing the dorsolateral folds. There are many more along the sides. The arms and legs



are conspicuously barred; and the throat, breast, and much of the under side of the hind legs is heavily dotted with dark. The males have yellow on folds, tubercles, iris, axilla, and groin, while the females have little or no yellow.

Structure: Wedge-shaped body, wide in head and slender in waist; tubercles on back; thumbs of males somewhat enlarged and darkened; males with vocal sacs from angle of mouth halfway to the groin.

Voice: The lateral pouches on each side of the neck, extending posteriorly halfway down side of body, inflate to a size nearly equal to that of the frog's head. The call is a deep hollow roll, intermediate between a snore and a groan: *yawh h h h h*, *yawh h h h h*.

Breeding: They breed from April to August 17. The eggs are in a large plinth-like mass about 6×8 inches and $1\frac{1}{2}$ inches deep. The egg is $\frac{1}{12}$ inch (2 mm.), the outer envelope $\frac{1}{5}$ inch (5.2 mm.), the inner $\frac{1}{8}$ inch (3.8 mm.). They hatch in $4-4\frac{1}{2}$ days. The tadpole is large, $3\frac{3}{8}$ inches (84 mm.), full and deep bodied, the venter strongly pigmented, the tail long. The color may be greenish, with yellowish on the top and sides of the head, the belly yellowish. The tooth ridges are $\frac{2}{3}$. After a tadpole period of 85 to 100 days, they transform from August to November 1, at $1\frac{1}{12}-1\frac{1}{2}$ inches (27-38 mm.).

Notes: In their normal all-the-year habitat, the sandhills and turtle burrows, they are seldom seen unless one deliberately seeks them. They usually rest at the mouth of the burrow, sometimes a foot or so down the decline, more rarely a foot or more from the incline, or may be on a little clear smooth place, 6 inches in diameter, a short distance from the hole. One area we visited frequently. From mid-forenoon to mid-afternoon, they were seldom out. On July 2, 1922, we visited this area at 2:30 and noon and found only one out, but at midnight, we readily found eight.

July 17, 1921. Okefinokee Swamp, Georgia. We sought out a group of gopher frogs we were hearing in the shallower western portion of the pond. One was beside a cypress tree in a depression of fibrous roots. I put the light on its nose and tried to push it back with my fingers. Then it leaped. At the base of a pine on a pile of chips $1\frac{1}{2}$ feet above the surface was another croaker. After a time, it would "bat" its eye toward the bullseye. These frogs were not hard to catch when discovered, but they were shy. Often when first put under light they would sink back into the fibrous roots, depressions and covers. One was spread out in the water amongst the spice bushes. The influence of nearby croakers seemed to stimulate this one as it does others. We caught several, put them in a bag, and induced these to croak. In this way the sprawled-out specimen responded beautifully with his croaks.

Northern Gopher Frog. Gopher Frog. Texas Frog. Florida Frog. Crayfish Frog. Hoosier Frog.

PLATE LVIII. 1, 4. Females ($\times \frac{1}{2}$). 2. Female ($\times \frac{1}{3}$). 3. Male ($\times \frac{1}{3}$).

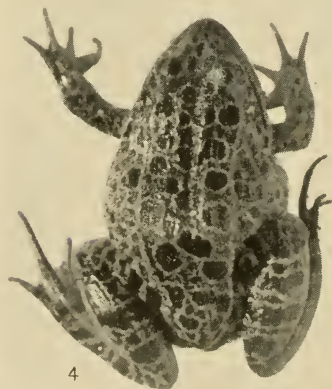
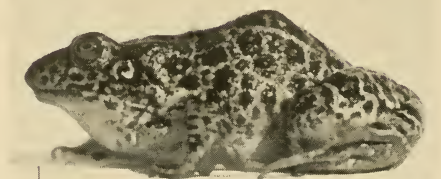
Rana areolata Baird and Girard.

Range: Texas, Oklahoma, Missouri, Ohio, Indiana, Illinois and Kansas.

Habitat: Old burrows, commonly crayfish burrows in the vicinity of ponds. The burrow entrance was often three inches in diameter and overhung with grass.

Size: Adults, 2 $\frac{1}{2}$ –4 $\frac{1}{2}$ inches. (Males, 63–103 mm. Females, 75–113 mm.).

General appearance: March 1, 1930. Frogs from Calhoun, Ill. This is a large brownish frog with round dark brown spots on back and sides. These spots may vary in size, as large or small. There are three or four rows between and sometimes extending on to the dorso-lateral folds and several irregular rows or groups on the sides. The spots are surrounded with grayish white borders which on the lower sides become the background color between the spots. On the back, the area between the dark spots is a speckled drab or grayish olive. The skin of the back is roughened with tubercles. There are one or two long glandular folds



on the tibia. There is considerable greenish yellow in the groin and on the concealed portions of legs and feet. There is a prominent dark bar on the brachium, a broad, fleshy, spotted band along the jaw, and a light center to the tympanum. The light color on the arms and jaw is quite grayish. There are several smaller, light rimmed, dark spots on eyelids, between the eyes and on top of the snout. The legs are prominently barred with brown and cream or gray. In this group, the frogs have a few dark spots just forward of the arm insertion. When cold and wet, the frogs were very dark. The vocal sacs of the males are large and conspicuous when collapsed, and bluish gray green in color. When expanded they form large balls on either side above the arms. (When plowed out in early spring they are so dark as to be almost blackish.)

Structure: Large; skin warty on back and sides; head shorter, mouth smaller and hind limbs longer than *R. aesopus*; males having prominent, collapsed, pleated, vocal sacs resting outside like folds of skin and continuing along the sides as folds past the axil; the middle of the sac being back of the tympanum; thumb somewhat enlarged in the male; eye conspicuous, but small in relation to snout; fourth toe very long; a thickened or fleshy band along the edge of the jaw. On the breast, the arm insertion with the pectoral girdle is conspicuously indicated by a triangle of much thinner skin, the base at arm's insertion, the point at the pectoral region; waist slightly broader, thus making whole form less wedge-shaped than *R. aesopus*.

Voice: "A loud trill, hoarser than that of the leopard frog and pitched somewhat higher than that of *Rana catesbeiana*."—(C. Thompson, 1915, p. 6). To Mr. Ackert, the call sounds "half-strangled" as if it had its mouth half out of water. "A deep guttural snoring sound with a slight upward crescendo at the end."—(Wright and Myers, 1927).

Breeding: They breed from March to April. The eggs are in large masses. The tadpole is not yet described. Transformation takes place the first week in July at 1 1/5 inches (30 mm.).

Notes: "This species was much more common in this region than is ordinarily supposed; its cry, if not the frog itself, being familiar to almost everyone who listens to frog voices in the spring. It was much more wary and difficult to catch than any other species of the vicinity, and perhaps this habitual shyness, and the fact that it remains quiet throughout the day and in or near its burrow all the year except during the breeding season, may account for its being so little known. As observed in Franklin County, Kansas, it began to sing about the middle of March and continued to sing a relatively short time. It was not heard after the middle of April."—(Howard K. Gloyd, 1928, p. 117).

Oregon Red-legged Frog. Western Wood- frog. Western Wood Frog.



PLATE LIX. 1. Male ($\times \frac{2}{3}$).
2. Female ($\times \frac{1}{2}$). 3. Female
($\times \frac{2}{3}$).

Rana aurora aurora (Baird
and Girard).

Range: British Columbia,
Washington, Oregon, south
along the coast of California
to Eureka.

Habitat: Amongst the vege-
tation of the coastal belt
forests.

Size: Adults, 1 $\frac{3}{4}$ -3 $\frac{1}{2}$
inches. (Males, 44-63 mm.
Females, 52-87 mm.).

General appearance: Dis-
tinctly a wood frog, the mask
is evident in many. It is
medium in size, moderately
stout, and smooth skinned.
The head is narrowly oval
from above, the profile thin.
The back is brownish or olive
frequently with inky spots,
sometimes becoming blotches.
Sometimes a few of these
spots have light centers. Fre-
quently there is a dark bar
across the upper arm. The
under surfaces are light, ob-
scurely mottled with dark.
There is red on the sides of
the body and on the con-
cealed parts of the legs, feet
and under arms. The light
line along the upper jaw ends
in a fold at the corner of the
mouth.

Structure: Frog medium in
size; skin smooth; ridge from



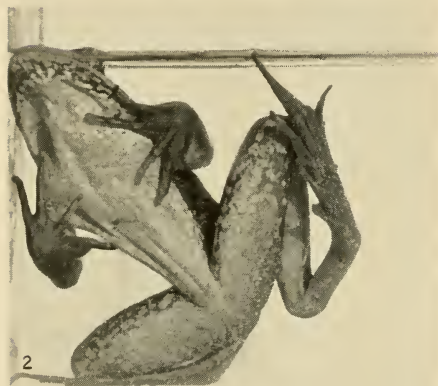
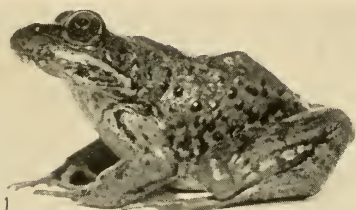
angle of eye to shoulder, not prominent; dorsolateral folds indistinct; webs very well developed, greater in males than females; some males with inconspicuous groove across middle of thumb tubercle.

Voice: Not recorded.

Breeding: They breed during June and July. The eggs and tadpoles have not been described. They transform at 11/16-4/5 inch (17-21 mm.).

Notes: "*Rana aurora* is a delicately formed, smooth frog, less hardy than most frogs of North America. . . . It is shy and wild, and difficult to keep in captivity, except in a perfect imitation of its environment. In such a place, it seems to enjoy equally sitting under the shade of ferns or in the water, and eats earthworms greedily. Both male and female give high-pitched, jerky cries, expressing fright, when taken in hand. One unusually large specimen opened his mouth wide and gave a prolonged high-pitched scream, reminding one of the similar sound produced by the common bullfrog.—(From THE FROG BOOK, by Mary C. Dickerson, copyright, 1906, by Doubleday, Doran and Company, Inc., p. 217).

California Red-legged Frog. Drayton's Frog.



Bull-frog. Long-footed Frog. Bloody Nouns. Rocky Mountain Frog. Western Wood Frog. Leconte's Frog. French Frog.

PLATE LX. ($\times \frac{1}{2}$). 1, 2, 4. Females. 3. Male.

Rana aurora draytonii (Baird and Girard).

Range: Oregon to Lower California.

Habitat: Ponds, lakes or marshes. Large permanent pools or water courses.

Size: Adults, 2 $\frac{1}{3}$ –5 $\frac{2}{5}$ inches. (Males, 63–95 mm. Females, 58–136 mm.).

General appearance: This is a large, stout, rough-skinned frog with a thick broad head. It is the largest of California's native frogs. The leg bars on tibia and femur may be so prominent as to appear zebra-like. The back is olive drab or buffy brown, spotted with light centered spots; the groin, heavily spotted; the lateral fold, light pinkish cinnamon; the line on the upper jaw cream buff or pale pinkish. The under side of the hind legs and the inner half of the tarsus and foot are pinkish to red. The iris is orange.

Structure: Thumb enlarged, slightly two lobed; thumb base quite large in female and in some individuals would be mistaken for a male; promi-

ment ridge from posterior angle of eye to shoulder; skin thick and roughened with many small papillae, even the ear drum may be so roughened; ear drum small; dorsolateral folds prominent; sacral hump prominent; back with regularly placed light centered spots; male without visible vocal sac.

Voice: It is a low tremulous gurgle.

Breeding: They breed during January and February. The eggs are laid in overflow areas of permanent pools, the mass attached to vegetation. The jelly is soft and viscid; the outline of individual eggs evident on the surface. The egg is $1/12$ inch (2.1 mm.), the envelopes $1/8$, $3/16$, $3/8$ inch (3.5 mm., 4.4 mm., 8.5 mm.), the eggs black and white. The dark brownish, mottled tadpole is $3\ 1/3$ inches (83 mm.) and has tooth ridges $2/3$. The larval period is 5–7 months. (Data from Storer, 1925.) They transform from May to August at $7/8$ – $1\ 1/5$ inches (22–30 mm.).

Notes: "It is said by people of the western coast that *Rana Draytoni* is the best edible frog in North America, and that the flesh of the Eastern Bullfrog is tough and coarse compared with it."—(From THE FROG BOOK, by Mary C. Dickerson, copyright, 1906, by Doubleday, Doran and Company, Inc., p. 216).

California Yellow-legged Frog. Thick-

skinned Frog. Boyle's Frog.

PLATE LXI. 1. Male ($\times \frac{2}{3}$).
2, 3. Females ($\times \frac{3}{5}$).

Rana boylei boylei (Baird).

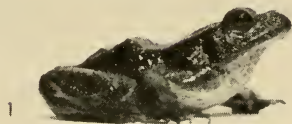
Range: Western Oregon, northern and central portions of California, chiefly west of the high Sierra Nevada.

Habitat: "Life-zones, upper Sonoran and Transition. Inhabits margins of springs, streams, and fresh-water lakes." (Grinnell-Camp, 1917, p. 146).

Size: Adults, 1 $\frac{3}{5}$ -3 inches. (Males, 39-67 mm. Females, 40-75 mm.). Smallest of the three subspecies of *Rana boylei*.

General appearance: This is a small frog with stout, broad body. The skin on the back, legs, and tympanum is thick and rough with small brownish papillae. The color of the back is black, light gray, greenish or brownish with indistinct dark mottling. There is a patch of lighter color on top of the head with a darker area behind crossing the upper eyelids. The tympanic region is darker than the head. Red is never present in the coloration. The venter is white with pale yellow on the posterior part and on the hind legs. The throat and sides of the body are mottled with blackish.

Structure: Head broad and pointed; web of foot large



only slightly scalloped; toes blunt, tips slightly expanded; thumb of male enlarged, the swelling having 2 lobes; tympanum small, distinct.

Voice: No description of the call is recorded. It has internal vocal sacs.

Breeding: They breed from the latter part of March to the first of May. The egg mass in shallow water toward the margin of streams, is attached to sides of stones in the stream bed, and is like a compact cluster of grapes, the individual eggs on the surface distinct, the jelly firm. The eggs are black and white, with 3 envelopes. The egg is $1/12$ inch (2.2 mm.), the envelopes $1/10$, $1/8$, $3/16$ inch (2.5, 2.8, 4 mm.). (Data from Dr. Storer, 1925). The tadpole is medium, 2 inches (50 mm.), deep olive in color, and with tooth ridges $7/5$. After a tadpole period of 3 to 4 months, they transform from June to September, at $4/5$ – $1\ 1/5$ inches (20–30 mm.).

Notes: "This little frog inhabits the slow flowing streams of the coastal areas, and may be found in considerable numbers in the semi-permanent pools, formed as the streams become low at the end of the rainy season."—(Slevin, 1928, p. 139).

"On the road from San Rafael to Bolinas in Marin County, California, at a point about 6 miles west of San Rafael, four of these little frogs were found near a roadside spring from which a small streamlet of clear water trickled over a bed of stones and gravel.

"Others were secured at the edge of Lake Merced, San Francisco County, California, in moist, but relatively open places. Here two methods of escape were observed: (1) Diving into the water and hiding there under the cover of aquatic vegetation, and (2) jumping into the thickets of land vegetation on the banks above the shore line."—(C. E. Burt and M. D. Burt, Nov. 19, 1929, p. 432).

Sierra Madre Yellow-legged Frog.

PLATE LXII. ($\times \frac{2}{3}$). 1, 2. Females. 3, 4. Males.

Rana boylii muscosa Camp.

Range: San Gabriel, San Bernardino, and San Jacinto mountains of southern California.

Habitat: "Occupies the upper Sonoran and Transition life zones. Lives along streams in narrow rock-walled canons."—(Grinnell-Camp, 1917, p. 148).

Size: Adults, $1\frac{4}{5}$ – $3\frac{1}{4}$ inches. (Males, 45–66 mm. Females, 47–81 mm.).

General appearance: "Like *Rana boylii boylii*, but attaining much larger size, and (except in young) with no light patch in front of dark areas across upper eyelids. Dorsal ground color usually lighter than in *R. b. boylii*, light yellow to brown, contrasting with the darker moss-like patches on the back. Tips of toes more expanded than in *boylii*."—(Camp, 1917, p. 119).

Structure: Tips of toes more expanded than in *R. boylii boylii*; dorsolateral fold indistinct, not pitted anteriorly; tympanum and area surrounding it very rough, covered with small tubercles; web of hind foot extending nearly to tips of toes, broader in expanse than in *R. b. boylii*; swelling on thumb of male has two lobes, the constriction being diagonal, not transverse.



Voice: Nothing on record.

Breeding: They breed during April. The eggs are not yet described. The tadpole is much like that of *R. boylii sierrae*. Its body is rather flat, the tail musculature heavy and almost uniform in width for about half the length of tail. Tooth ridges are variable, for example, $3/4$ in one, $3-2/3$ in another. Possibly they winter as tadpoles and transform in the spring. They transform at about $4/5$ inch (20 mm.).

Notes: "*Rana boylii muscosa* inhabits the deeply cut valleys and gorges, of the San Gabriel, San Bernardino and San Jacinto mountains, from at least the Arroyo Seco Cañon near Pasadena, on the northwest, to Keen's Camp, Riverside County, on the southeast. It readily climbs the steep rocks bordering the cañon streams, employing for this purpose the enlarged tips of the digits, and sits far above the water during the day; when alarmed it dives directly into the stream, kicks up the silt with its hind legs, and buries itself in the mud, so that pursuit is rendered difficult."—(Camp, 1917, p. 120).

Sierra Nevada Yellow-legged Frog. Western Frog. Pacific Frog. Stink Frog.

PLATE LXIII. 1, 3. Females ($\times \frac{3}{5}$). 2. Male ($\times \frac{4}{5}$).

Rana boyllii sierrae Camp.

Range: California. Southern half of Sierra Nevada, above 7000 feet altitude from Yosemite National Park on the north to Southern Tulare Co. on the south.

Habitat: Meadows, streams and lakes from 7000 to 10,500 feet in Yosemite Park, and to 11,500 feet near Mount Whitney.

Size: Adults, 1 $\frac{3}{4}$ -3 $\frac{3}{8}$ inches. (Males, 44-65 mm. Females, 48-84 mm.).

General appearance: This frog is like *Rana boyllii boyllii*, but lacks the light patch on the head. The back is slightly roughened, is dark olive in color with some darker spots showing when he is wet. The under parts are white on the throat, creamy or buff on the belly and the under side of the legs. The throat is marked with black spots. The sides are light heavily mottled with distinct black blotches. The jaw is heavily mottled with light and dark. There is a distinct dark blotch on the upper part of the fore arm. The inner surface of the arms is light, outer surface greenish, marked with dark blotches. The legs are marked with dark spots. The angle of the jaw forms a swollen light



area marked with one or two dark spots, and back of this is another light tubercle or swollen area. The head is short and broad with the nostrils far apart.

Structure: Hind legs shorter; head relatively narrower; tympanum smoother than in *Rana boylii boylii*; web of hind foot very large, extending to tips of toes; tips of toes not much expanded; dorso-lateral fold strongly pitted anteriorly; swelling on thumb of male bilobate.

Voice: No data.

Breeding: As soon as ice has melted in the mountain lakes, they breed in June and July. The eggs are approximately like those of *Rana boylii boylii* (Storer, 1925). The tadpole is fairly large, 2 7/8 inches (72 mm.), its body flattened, the tail musculature wide for an inch or more, then suddenly tapering, the tail tip rounded or spatulate. The crests are broader toward the tip than at the body. The tooth ridges are 3/4 or 2/4. The period of development is 1 year, the animal passing the winter as a tadpole. It transforms, during July and August, at 7/8-1 1/12 inches (21-27 mm.).

Notes: August 23, 1917. Alta Meadows, California. In the pools on the mats were plenty of *Rana boylii sierrae*. They stink like minks or other weasels. They are very slow. One can run a net under them or put a net on the bottom in front and touch the back parts. They are very yellow underneath. The species is almost through transformation. The larvae look on the venter somewhat like large toad tadpoles. We found a few transformed individuals.

"This subspecies was found to be abundant in the vicinity of a fair-sized mountain stream which runs alongside the road from Placerville to Lake Tahoe in Eldorado County, California, at a point about 40 miles west of Lake Tahoe. There was very little vegetation along the broad stream, which flowed moderately and with a depth varying from one to three feet. The bed of the stream, easily seen through the clear water, was essentially of stones, gravel and sand. The frogs were usually resting at the water's edge, but they jumped into the water and hid under stones as we approached. A number were secured with the fingers after they had been pinned to the rocks under which they were seen to take refuge or after they had been trapped in some under-water crevice.

"Mr. Oliver Millard has recently sent us a series of this form which he collected in the Sierra Nevada Mountains along a tributary of the north fork of the Stanislaus River at an elevation of 6,500 feet, 15 miles northwest of Calaveras, Calaveras County, California."—(C. E. Burt and M. D. Burt, Nov. 19, 1929, pp. 432, 433).

The Northern Wood Frog. Cambridge Frog.

PLATE LXIV. ($\times \frac{4}{5}$). 1, 4, 5. Females. 2, 3. Males.

Rana cantabrigensis Baird.

Range: Alaska and British Columbia, through the lowlands east to Michigan and Ontario.

Habitat: Terrestrial except at breeding periods, living in woods amongst dead leaves or moss.

Size: Adults, 1 $\frac{2}{5}$ –2 $\frac{1}{4}$ inches. (Males, 36–50 mm. Females, 37–56 mm.).

General appearance: This is a short-legged northern form of the wood-frog, with a dark vitta or mask from the eye over the tympanum, and with a light line along the jaw. Many of these small wood-frogs are grayish in color with an irregular dark brownish band on the back, and a light median dorsal stripe. In some, this stripe extends from snout to vent, in others, to varying distances or is entirely lacking. There is a prominent dark brown stripe on the snout joining the dark mask back of the eye. This is bordered below by a light yellowish or buffy stripe. The costal fold is bronzy. In many frogs, there may be dark spots bordering the costal fold below, on the dorsum or on the sides. Some are almost free of dark spots. The throat and breast are usually speckled. The majority of wood-frogs from Pem-



bina, N. D., seem to possess the light median dorsal stripe, although it is by no means universal. Those of Itasca Park, Bemidji, and points further south are more inclined to brown without the light median stripe. Several frogs from Wisconsin have the following characters: The legs are barred with black; there is considerable green in the mottling of the rear of the femur and in the groin; there is rather heavy mottling on the pectoral region and on the lower throat; the hind legs average shorter than in the typical *R. sylvatica* and the frogs attain breeding characters at a much smaller size than we find in *R. sylvatica*.

From examination of material in the National Museum and other museums, we observed that, sometimes in the same lot, there may be individuals of the same sex, one with the mid-dorsal line, one with it absent. In the same way, the light tibial stripe may be absent or present in the same lot.

Structure: Body stout; legs shorter and stouter than in *Rana sylvatica*; heel reaching tympanum or eye; tibia 3-4 times as long as broad; tibia $1\frac{1}{2}$ length of body; back, flanks and lower belly smooth; tympanum smooth; thumb of male enlarged; greater webbing in hind foot of males.

Voice: The call is a hoarse clacking. It has no external vocal sac and calls from the surface of the water.

Breeding: They breed from March to July dependent upon the portion of range, March-April in Michigan, May-July in Mackenzie region. Like *R. sylvatica* the eggs are in masses attached to vegetation. The tadpoles are like those of *R. sylvatica*. They transform from May 25-September 15 at $3\frac{3}{4}$ - $7\frac{7}{8}$ inch (18-22 mm.).

Notes: Aug. 30, 1930. Pembina, N. D., Red River of the North. The river is low, with a zone of six feet of bare mud inclined, exposed and broken into blocks. Next comes a zone of low weeds and grasses, then dense low willows extend up the bank for two rods or more. It is very dry and baked amongst them.—Above, are upland meadows and cultivated fields. Along the moist edge of the vegetation we took several median-striped northern wood-frogs. We took an adult male with the median stripe half way to vent, a male without median stripe, a female with median stripe from snout to vent, and one without median stripe, and several young with and several without the median stripe. All were quite spotted on the breast. The dark pattern on the back was quite conspicuous. This is the finest series of northern wood-frogs we have taken or seen alive.

Bullfrog. Bloody Nouns. Bully. Jug-o'-Rum.

PLATE LXV. 1, 4, 5. Males ($\times \frac{3}{8}$). 2. Female. 3. Tadpole ($\times \frac{3}{8}$). 6. Eggs ($\times \frac{1}{6}$).

Rana catesbeiana Shaw.

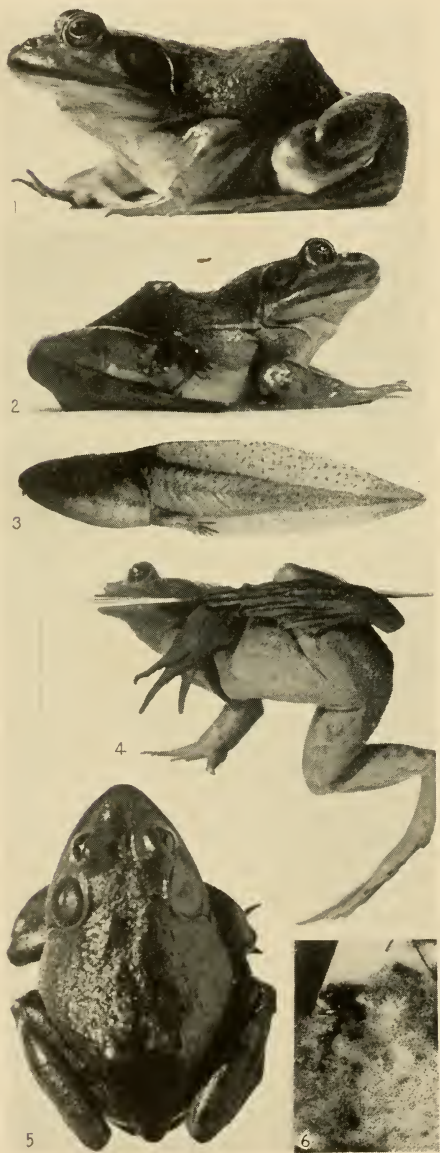
Range: Canada to Mexico east of the Rockies. Also introduced into western United States.

Habitat: Strictly aquatic, these frogs seem to prefer mill ponds, hydraulic lakes, reservoirs and kindred bodies of water.

Size: Adults, 3 $\frac{2}{5}$ –8 inches. (Males, 85–180 mm. Females, 89–184, possibly 200 mm.). The species seldom breeds before it reaches 4 inches (100 mm.).

General appearance: The bullfrog is our largest frog. It is rather broad in body. In the north it is usually a greenish drab on the back and yellowish white underneath. The skin may be roughened with fine tubercles. There is no lateral fold, except a short fold over and behind the tympanum. There are a few dusky spots on the legs. This frog in the Gulf Region may be so dark as to be almost black on the back and heavily mottled beneath, and even the webs of the feet may be almost black.

Structure: No ridges down either side of back; web of fourth toe extends to its tip; male with internal vocal sacs, inflation a flattened pouch



beneath chin; male with tympana larger than eye; head narrow.

Voice: Its sonorous bass notes have received countless characterizations, among which are the familiar, *jug-o'-rum*, *more rum*, *blood 'n' ouns*, *br-wum*, *be drowned*, *knee deep*, and *bottle-o'-rum*. These notes have wonderful carrying power and are commonly heard in the evenings of early summer.

Breeding: In the north, they breed the last of June or in July when the air temperature is about 80 degrees and the water has warmed up to 70 degrees. In the south, they breed much earlier. We found an egg mass in San Antonio, Texas, Feb. 12, 1925. The egg mass is a large surface film 2 x 1 1/2, 2 x 2, or 2 x 2 1/2 feet; the eggs, black and white, are 1/20-1/15 inch (1.2-1.7 mm.) in diameter. There is no inner envelope and the outer merges into the jelly film. The tadpole is large, 4-6 3/5 inches (100-165 mm.), olive in color with fine speckings of black, and with the tooth ridges 2/3, rarely 3/3. In the north it spends two winters as a tadpole, and transforms from July 1 to August 15, or in the south, from last of May onward, at 1 1/4-2 3/8 inches (31-59 mm.).

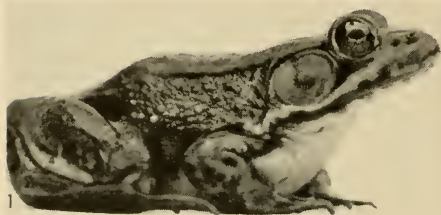
Notes: At Ithaca two habitat factors are important: shallows where the species can transform; and brush, stumps, driftwood or matted roots of fringing willow trees. When croaking begins, the males often take certain perches in which they keep a proprietary interest. About one pond, the author once located seven such places, each with its possessor, only once finding two in one place. . . . When, however, the males about a lake are numerous enough to make their night croaking a real chorus, . . . it is not likely that any one individual holds a favorite site to the exclusion of others.

The bullfrog is a solitary form.

June 30, 1913. Otter Lake, Dorset, Ontario. Bullfrogs in chorus. . . . The other day the boys caught 29 with a red flannel hook. The following evening with electric flashlight, we caught 15. The next day we captured 20 more. When I cleaned them, none of the females had laid. . . . Furthermore, we found no eggs in the field. Surely this is the wrong season to catch them. Their capture should not be allowed until the middle of July or the beginning of August.

June 4, 1917. Camped at Broad river. S. C. . . . In long shallow pools, 2-3 ft. deep, where plenty of yellow water lilies grow, we found three masses of bullfrog eggs. One fresh mass was 2 1/2 x 1 1/2 ft. in diameter and was at the surface around the stems of a yellow water lily. Another mass looked like cooked rhubarb and was more or less dirty. In another case, the egg mass was on *Chara* which surrounded the stems of the water lilies. Here there were plenty of adult bullfrogs.

Green Frog. Pond Frog. Spring Frog.



Common Spring Frog.
Bullfrog. Bawling Frog.
Yellow-throated Green
Frog. Belly Bumper.
Bully. Screaming Frog.
Black Frog. Bronze
Frog.

PLATE LXVI. 1. Male ($\times \frac{2}{3}$)
2. Female ($\times \frac{1}{2}$). 3. Hind foot
($\times \frac{1}{2}$). 4. Eggs ($\times \frac{1}{5}$). 5. Female
($\times \frac{2}{3}$).

Rana clamitans Latreille.

Range: Eastern North
America. Gulf of Mexico to
Hudson Bay.

Habitat: A solitary species.
Like the bullfrog, it lives in
swamps, and in our deeper,
larger ponds and reservoirs,
but the green frog also lives
in smaller ponds and pools.
In fact, along water courses
there is hardly a small pond
which cannot claim a green
frog. Hibernates in the water.

Size: Adults, 2-4 inches.
Smaller in the south. (Males,
52-72 mm. in the south, and
reaching 95 mm. in the north.
Females, 58-75 mm. in the
south, reaching 100 mm. in
the north.).

General appearance: This is
a yellow-throated bullfrog.
In the north the green frog is
one of our largest frogs. It
has a prominent dorsolateral
fold with a branch extending
almost at right angles down-
ward behind the tympanum
which is large and con-
spicuous. The general color is

a greenish brown with a bright green mask from the tympanum forward along the jaw. The skin may be slightly roughened with small tubercles. The legs have dusky bars. An occasional green frog has a few scattered black spots on the back. They are white beneath, the male having a yellow throat.

Structure: A large frog; skin smooth; broad short fold of skin on which is a yellowish white stripe extending from angle of mouth over arm insertion; dorsolateral fold $1/2$ – $2/3$ distance to hind limb; fourth toe free of webbing on last two phalanges; male with enlarged thumb and tympanum; male with ring of yellow in tympanum; male with throat a bright yellow; the swollen throat of the croaking male is a flattened pouch not a ball-like sac; the vocal sacs being termed internal.

Voice: The call is low pitched, explosive. The note resembles that made by plucking the string of a bass viol or the twang of a rubber band slightly stretched over an open box. The male rests on a mat of vegetation or amongst grass or aquatic plants, or freely sprawled out on the water. Usually the hind quarters are slightly submerged.

Breeding: In the north they breed from the end of May to mid-August, but in the south they are late breeders. The black and white eggs are in a surface film usually less than a foot square, and number 1,000–4,000. The egg is $1/16$ inch (1.5 mm.), the inner envelope elliptic, the outer merging into the jelly film. The olive green tadpole is large, $2\ 9/16$ inches (64 mm.), its tail elongate, green mottled with brown, and with tip acute. The tooth ridges are $2/3$, rarely $1/3$. It spends one winter as a tadpole and transforms from April to September at $7/8$ – $1\ 1/2$ inches (23–38 mm.). Many transform at smaller size in the south.

Notes: June 21, 1907. Slaughter House Pond, Forest Home, Ithaca, N. Y. I found out in the middle at the surface, eggs laid by six pairs. In one case the complement was distributed in four groups about a foot apart. In other cases, they were generally in one mass. They were readily distinguishable because of the excessive amount of air bubbles amongst them.

June 16, 1910, Ithaca, N. Y. East Bools. I heard *Rana clamitans*. In the west stretch was one solid mat of water weed. On the top of this at surface was a film 9 inches in diameter apparently fresh. A little farther on were two other films, irregular crescents, one on open water. . . . In shallow water were two bunches two days old, one other bunch a composite of two with a diameter 15 inches x 10 inches, another bunch in deep water, fresh but already distributed in little packets. Along the west side were five fresh films, one 14 inches x 9 inches, but looking like two, another bunch about hatched.

Southern Bull-frog. Joe Brown Frog. Pig-frog. Swamp Bullfrog. Bonnet's Frog. Lake Frog. Green Bull-frog.



PLATE LXVII. I. Female ($\times \frac{1}{4}$). 2. Male croaking ($\times \frac{1}{8}$). 3, 4. Females ($\times \frac{1}{3}$).



Rana grylio Stejneger.

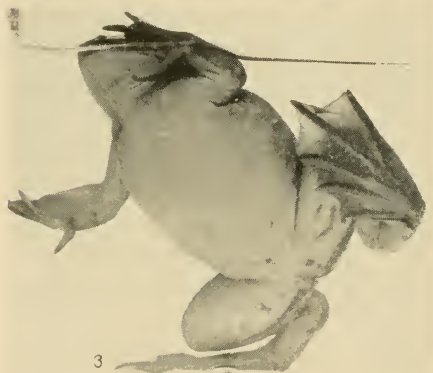
Range: Louisiana to Florida and southern Georgia.

Habitat: Aquatic. Open water-lily prairies, open ponds, or along deep-wooded overflowed banks of southern rivers, amongst brush or similar debris, or amongst aquatic vegetation, like pickerel weed, and more especially near bushy edges. (Exceedingly shy, hard to catch except at night with a light.)

Size: Adults, 3 $\frac{1}{4}$ –6 $\frac{2}{5}$ inches. (Males, 82–152 mm. Females, 85–161 mm.).

General appearance: This is a large frog similar to the common bullfrog and varies from brownish olive to bone brown or blackish brown above, with some prominent, scattered black spots. The under parts often have a network of black, brown and yellow, presenting a striking heavily mottled appearance. It has no dorsolateral folds.

Structure: Large frog; no dorsolateral folds; male with internal vocal sacs, the inflation forming a flattened pouch on throat with extra inflation on either side, giving the pouch a three-parted ap-



pearance; more pointed head and narrower snout than in *R. catesbeiana*, and with all the hind toes except the fourth proportionally longer; webs to the tips of toes.

Voice: The call is a grunt like that of pig or an alligator. It is rough and guttural.

Breeding: They breed from May 1 through September, generally in humid weather, with night temperatures of 65-70 degrees and day temperatures of 85-90 degrees. The crest is in June and July. The black and white eggs are in a surface film 12 x 12 inches to 12 x 25 inches, and attached to vegetation. The egg is 1/16 inch (1.6 mm.), the outer envelope 1/6-1/4 inch (4-6 mm.), merging into the jelly mass. The greenish tadpole is quite large, 4 inches (100 mm.) with tail long, sharply acuminate. The tooth ridges are 2/3. After a tadpole period of 1 to 2 years, they transform from April 24 to July 19, at 1 1/4-2 inches (32-49 mm.). A young transformed *R. grylio* looks much like an adult or half grown Carpenter frog, (*R. virgatipes*).

Notes: On April 25, 1921, (Billy's Island) we went with flashlights after *Rana grylio*. On the vegetative carpet and lily pads were untold numbers of *Acris*, on the lily pads and on the bushes, *Hyla cinerea*, and amongst the pickerel weeds, different sizes of *Rana grylio*. In all, three of us secured only 6 adults and one transformed specimen. Later I found that they could be picked up rather easily with a flashlight.

On May 6, Dave Lee went out on Billy's Lake at night with a torch to catch small fish for bait. With a small dip net he would scoop in front of a *Rana grylio*, and usually catch it. All in all our main reliance was to wade about at night on the 'prairies' or in open cypress ponds and by means of a flashlight catch them by hand.

On May 11, we found plenty of *R. grylio* at night along the edges of Billy's Lake. They usually were at the edge near the bushes or under them amongst brush or in maiden cane. Usually when one tried to photograph them they were too much surrounded with vegetation or sticks.

Greenback. Heckscher's Frog. River-swamp Frog. Wright's Bull-frog.

PLATE LXVIII. 1, 4. Females ($\times \frac{3}{8}$). 2. Tadpole ($\times \frac{1}{2}$). 3. Male ($\times \frac{3}{8}$). 5. Hind foot ($\times \frac{3}{4}$). 6. Young tadpole ($\times \frac{1}{2}$).

Rana heckscheri Wright.

Range: Coastal South Carolina to Callahan, Florida, west to Biloxi, Miss., (Allen) and possibly to Louisiana.

Habitat: Swampy edges of rivers and streams, a truly fluviatile species.

Size: Adults, 3 $1\frac{1}{4}$ -5 inches. (Males, 82-131 mm. Females, 102-131 mm.).

General appearance: This is a large greenish black, rough skinned frog with the venter very heavily mottled with black. The throat of the male has a wash of yellow on a light gray background. The edge of lower jaw with light spots of white, yellow or buff, is similar to the green frog. The center of the ear drum is rough, light brown or greenish buff, with the remainder very dark, almost black. The webbing on the foot does not extend to the tip of the fourth toe, leaving about $1\frac{1}{2}$ joints free.

Structure: Upper parts sometimes very warty; no lateral fold; center of ear drum granular and light in color; 1st, 2nd, 3rd, and 5th toes shorter than corresponding toes of *R. grylio* and *R. catesbeiana*; 3rd toe con-



tained 3.3-3.8 in total length of body in *R. heckscheri*, while 2.7-3.1 in total length in the other two species; 4th finger shorter, contained 8.0-8.6 in the total length, while 5.6-7.1 in total length in the other two species; internasal space less than the upper eyelid width in this species while greater or equal in the other two; males with tympanum much larger than eye; thumb enlarged, and throat darker and with yellow; back more warty, in male.

Voice: One call is a snore or snort, and another a peculiar, snarling, explosive grunt.

Breeding: They breed from April to mid-July. The eggs are probably a surface film. The tadpole grows large, 3 7/8 inches (97 mm.). The young tadpole is black with a gold band across the body and the tail clear. The mature tadpole is dark in body with black-rimmed tail crests. The tooth ridges are 2/3 or 3/3. The tadpole period is probably 2 years. It transforms in June at 1 1/5-1 9/16 inches (30-39 mm.), sometimes at 2 inches (49 mm.).

Notes: In August 1922, with a light we captured eight or ten frogs of various sizes from one year frogs to full size adults. We found them in the shrubbery and on the banks about the bases of trees.

June 9, 1928., Callahan, Fla. Later we went over to Mr. Davis' brick yard pools and found many transforming frogs here and countless tadpoles. Sometimes these tadpoles were so thick, one could reach in with the hand and catch them. On the east side we saw an immense school of little black ones with the yellowish crossbands. Amongst them are some bigger ones about 1/2 inch in body. This means at least two lots have already bred. . . . These pools are with water lilies, arrow-head, water hyacinth and many other plants.

June 8, 1928. Callahan, Fla. This afternoon we went to the type locality for *Rana heckscheri* and saw lots of tadpoles amongst the vegetation. We captured about 12 transformed ones. One can approach them when their heads are out of water. Some rest on the mud of the bank. Many tadpoles here have four legs and a long tail. We went along in the pickerel weed on the east side of bridge where it is shady, 5 p. m., and finally saw a large one. We slowly approached from water side with a net and came close enough to catch frog. We started skirting several edges and soon saw another on the bank amongst pickerel weed. By crawling upon it we caught it, and it squealed. The children went along and frightened another which gave a startled note of the *R. catesbeiana* order. These two are the largest we have caught. They are bigger than any greenfrog. The transformed ones are somewhat like greenfrogs but with more intensified spotting on the belly. These transformed ones and the adults have no costal folds.

Nevada Frog.

PLATE LXIX. 1. Male ($\times \frac{3}{3}$). 2, 3, 4. Females ($\times \frac{3}{5}$).

Rana onca Cope.

Range: Utah and Nevada.

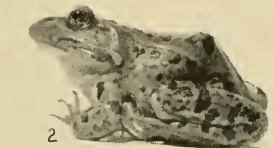
Habitat: Spring basins or trickling streams in springy fields. Isolated in such spots because of surrounding desert.

Size: Adults, 1 $\frac{3}{4}$ –3 inches. (Males, 44–64 mm. Females, 46–74 mm.).

General appearance: This spotted frog with light stripes along the dorsolateral folds, is very similar to *R. pipiens* or *R. palustris* or *R. septentrionalis*. The chamois or honey yellow of the hind legs is very prominent in both male and female, reminding one of *R. palustris*. The females are more spotted than the males. The upper parts are olive green, the males showing a tendency toward self color in the forward part of body. This forward part may be a brighter green. In the groin and on the front and rear of the hind legs are many reticulations of deep olive and pale olive gray.

Structure: Thumb enlarged in males; tympanic disk large and larger in males than females. Old males may be smooth, but younger ones may be more warty than corresponding females.

Voice: August 20, 1925. Las Vegas, Nev. When I picked up the tenth one, he



began to swell out his sacs back of his ears as are the sacs of *R. pipiens* and *R. virgatipes*. . . . I put them in a bag and carried them on my belt. A few times they gave semi-croaks which reminded me in some ways of *R. palustris*. . . . Once or twice I heard a very low croak. It must have been *Rana onca*.

Breeding: It probably breeds in the spring. The eggs are not known. The general color of the tadpole is dull citrine with the tail pale green yellow. The tail is elongate, its tip rounded. The largest tadpole we caught was probably not mature, being $1 \frac{5}{8}$ inches (42 mm.) and of the *R. clamitans* type. The tooth ridges are $\frac{2}{3}$. We caught no specimens at transformation. The smallest frogs we saw were $1 \frac{9}{16}$ – $1 \frac{5}{8}$ inches (39–42 mm.).

Notes: August 20, 1925. Las Vegas, Nev. We went out the Tonapah road . . . Then we turned back and about 3 miles from Las Vegas passed an artesian well pouring out a big stream of water, and then came to a low swampy area with quite a stream rushing on one side of it. No frogs were seen here. We drove a short distance to where on both sides of the road small springs came out of the ground in basins 3–4 feet across and ran as trickling streams down into the field. These had been artificially ditched. The streams were covered with algae. The region was grassy with a stiff grass. The immediate edges were sedgy. I first saw a frog jump into the tiny stream . . . just showing through a break in the algae. We caught him. He is the game we came for, *Rana onca*. Then across the road we found a large male near the spring hole . . . We found tadpoles in the spring hole. Two hundred and fifty extra miles of desert for a frog seems worth it when you find your game. We followed one tiny stream back into the field and returned with the trophies, 6 *R. onca*, 4 *Hyla regilla*, and 1 *Bufo compactilis*. The second frog we caught was in one of the headwater springs and was resting against the bank with $1 \frac{1}{2}$ inches of its head out. When I started to catch it, it swam only a short distance, didn't go into the bottom at all, just rested on the top of the bottom. I moved away the scum over it and yet it stayed in position. Then with a pan we began to scoop the area along the edges. The frog came to the top. They are very easy to capture, not what I would call extremely alert.

Pickerel-frog. Marsh Frog. Tiger Frog

(DeKay). Leopard Frog (DeKay). Cold Swamp Frog. Swamp Frog. Spring Frog. Le Conte's Leopard Frog.

PLATE LXX. 1, 3. Males ($\times \frac{2}{3}$). 2. Male croaking ($\times \frac{2}{3}$). 4. Female ($\times \frac{2}{3}$).

Rana palustris Le Conte.

Range: From central plains to Atlantic seaboard. From the Gulf States to Hudson Bay.

Habitat: Sphagnum bogs, marl ponds, cold streams, shallows of mill ponds, quiet water of bayous, rocky ravines.

Size: Adults, 1 $\frac{4}{5}$ -3 $\frac{1}{6}$ inches. (Males, 46-64 mm. Females, 49-79 mm.).

General appearance: The pickerel-frog at first glance looks much like the meadow frog. It is slender, smooth skinned, medium in size, usually brown in color, with light raised ridges extending backward from the eyes. The dark spots are, however, square in shape and dark bordered, regularly arranged in two rows with an occasional third spot between the dorsolateral folds, and covering more than one half of that area. The spots on the sides also are square and arranged regularly, the upper row close to the dorsolateral fold. There is a dark streak from the eye to the nostril. Underneath, it



is glistening white on the forward part and yellow or orange on the under side of the legs, in the groin and extending forward along the sides of the belly, and on the under side of forearms. The legs are barred with dark bands.

Structure: Thumb much enlarged in breeding males; vocal sacs of males small lateral swellings between the tympanum and the arm; the skin has strong acrid secretion, irritating to the mouth of the dog who tries to eat one. It will kill other frogs put in the same jar of water.

Voice: It has a low pitched grating croak with little carrying power, shorter and higher than *Rana pipiens*, and more prolonged and lower than *Rana sylvatica*. These males frequently croak beneath the surface of the water, while in the embrace.

Breeding: They breed from April 23 to May 15. They gather in large numbers, and often in a small area 6 feet square or less, one finds 12-15 pickerel-frogs mating or pairs laying. The brown and bright yellow eggs are submerged attached to twigs or grass stems, form a firm globular mass $3\frac{1}{2}$ -4 inches (87-100 mm.) in diameter, and number 2,000-3,000. The egg is $\frac{1}{16}$ inch (1.6 mm.) in diameter, envelopes $\frac{1}{9}$ inch (2.8 mm.) and $\frac{1}{6}$ inch (4 mm.), a little smaller than those of *Rana pipiens*. The tadpole is large, 3 inches (75.8 mm.), greenish in color, the body and tail covered with fine black dots, the tail crests black or very clouded, and the belly cream. The tooth ridges are $\frac{2}{3}$, $\frac{1}{3}$. After a tadpole period of 70-80 days, they transform in August at $\frac{3}{4}$ -1 $\frac{1}{12}$ inches (19-27 mm.).

Notes: Bool's, Ithaca, N. Y. April 28, 1911. When I approached the *Rana palustris* egg area, there were within an area of 3 feet square, 5 mated pairs and 21 unmated males. Of the mated pairs, the males were much lighter than the females. A female will back up to a stem and clasp it with hind legs; then change position or back to another stem. Sometimes this will be a stem with one to three or four egg masses on it already. . . . Already in this area were 8 egg masses.

"This frog is most loath to retire on the approach of winter and can often be found after the other Ranidae have retired. I have often, on warm days in winter, seen this species as it made its way over the dead leaves at the bottom of some spring, possibly looking for a warm niche into which it might retire on the return of cold weather.

"Being our most abundant frog and obtainable at almost all seasons of the year, it has come into good repute with the freshwater angler, and is often, as a whole or in parts, used as a bait for the omnivorous pickerel."—(H. C. Bumpus, 1886, pp. 7-8).

Meadow Frog. Leopard Frog. Shad Frog.

Herring-hoppers. Common Frog. Berlandier's Frog (*berlandieri*). Spotted Green Frog.

PLATE LXXI. 1. Female ($\times \frac{1}{2}$). 2, 5. Males ($\times \frac{1}{2}$). 3. Egg masses on the bottom of a pond ($\times \frac{1}{8}$). 4. Egg mass, plinth shaped ($\times \frac{1}{3}$).

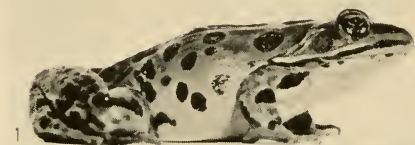
Rana pipiens pipiens Schreber.

Range: Widespread and common over North America, east of the eastern edge of the Pacific coast states, from the extreme north into Mexico.

Habitat: In spring, in swampy marsh lands, upland back-waters, overflows and ponds. In summer, in swamp lands, grassy woodland or hay or grain fields in cultivated districts. They spend the winter in pools or marshes.

Size: Adults, 2 $1/12$ –4 $1/12$ inches (Males, 52–80 mm. Females, 52–102 mm.).

General appearance: These frogs are slender in form, smooth skinned, medium in size, brown or green in general color, with two light raised stripes extending backward from the eye. Between these dorsolateral folds are two or three rows of irregularly arranged, rounded dark spots with light borders. On the sides are more rounded dark spots with light borders, irregularly arranged in three



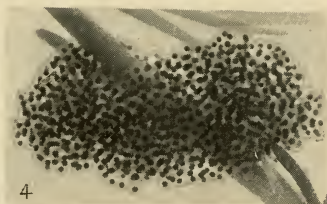
1



2



3



4



5

or four rows. There is a dark spot on the top of either eyelid. There is a light line along the jaw, below the ear and over the arm, bordered below with a dark stripe. The legs are barred with light-bordered dark bands. Beneath, it is a glistening white.

Structure: Lateral folds prominent; head shorter than *R. sphenoccephala*; snout medium; vocal sacs of males, lateral, between tympanum and arm; swelling out as round balls over the arms, with extensions down the sides; round spots on back outlined with light; more spots below dorsolateral fold than in *Rana sphenoccephala*.

Voice: The croak is a long, low guttural note, 3 or more seconds long, followed by 3-6 short notes each a second or less in length, or the short notes may precede or be interspersed. The call is given by males on the surface, or from males beneath the water on the bottom.

Breeding: They breed from April 1 to May 15. The egg mass is a flattened sphere, 3-6 inches (75-150 mm.) by 2-3 inches (50-75 mm.). The eggs are black and white, 1/16 inch (1.6 mm.) in diameter, the envelopes 1/8 inch (3.4 mm.) and 1/5 inch (5 mm.). The tadpole is large, 3 3/8 inches (84 mm.), the tail lighter than the body, its crests translucent marked with fine spots and pencilings. The tooth ridges are 2/3, 3/3. After a tadpole period of 60 to 80 days, they transform in July at 3/4-1 1/4 inches (18-31 mm.).

Notes: April 11, 1907. Ithaca, N. Y. In Bool's backwater, I found one bunch of *Rana pipiens* eggs. Just before I found them I heard a croak under my feet. There were two frogs trying to escape, a male and a female. . . . The dead stream running east furnished some good notes. I heard several croaks from frogs at the surface. It is a low croak. I captured a male *Rana pipiens*. Around were 8 bunches of eggs. *Rana pipiens* eggs are not in the spherical masses that we find with *Rana sylvatica*. They are more flat; the longest diameter may be 5 or 6 inches, but seldom is the other diameter more than 1 1/2 or 2 inches. *Rana pipiens* usually seeks places where the edges are grassy.

April 25, 1911. Dwyer's Pond, Ithaca, N. Y. Surface temperature 56°, bottom temperature 48°. I found several new bunches of *Rana pipiens* eggs, countless old bunches, immense *Rana pipiens* areas of 25-40 bunches, and several *Rana pipiens* croaking.

Plain Meadow Frog. Burns' Meadow Frog.

Unspotted Meadow Frog.

PLATE LXXII. ($\times \frac{3}{5}$). 1-6. Males.

Rana pipiens burnsi Weed.

Range: Southern Minnesota and northern Iowa, with possibly a few in western Illinois and Wisconsin.

Habitat: Swampy stretches and meadows.

Size: Average a little smaller than the common meadow frog (*Rana p. pipiens*).

General appearance: These frogs are built like meadow frogs. They have the long snout of *R. sphenocephala*. Their general color and first appearance is like a bronzy wood frog (*R. sylvatica*) without the black mask. The costal folds are long, prominently raised and frequently a light buff color. Some frogs are apple green, some wood brown. They have considerable green in the axil, groin and on the rear of the femur. Some have a prominent black dash on the arm insertion, a black spot on the elbow, and a prominent black band on the canthus rostralis. They are glistening white below.

Structure: Slender form; long pointed snout; long prominent folds on back.

Voice: When held just ahead of the hind legs, the



males inflate lateral vocal sacs exactly like the meadow frog, and emit a sound not unlike that species.

Breeding: Nothing recorded.

Notes: August 22, 1930. On the third floor of the Minneapolis Public Library, Mrs. Olive Wiley has a museum of reptiles and amphibia. One puzzle to her was a partly blue frog. It is the green frog (*Rana clamitans*). In one of her aquaria she had a *Rana* she alluded to as a wood frog. It had the size and general appearance of a wood frog, but very manifestly it was the meadow frog we sought, *Rana burnsi* of Weed. It is a very bronzy, beautiful frog. Later, Mr. O'Connor showed me another one which was green on the back. It too had no dorsal spots. The first one came from Coon Lake about 10-12 miles northeast of St. Paul. This extends the range of this species outside of the Minnesota River drainage.

August 23, 1930. We arrived at Spicer, Kandiyohi Co., Minn., at 5:30 p. m., and sought out Mr. M. F. Delaske who told us that he sometimes had plain bait frogs with no spots. . . . Mr. Oscar Hillman did not recall seeing meadow frogs without spots.

August 24, 1930. We started for Lake Florida and first went to Shady Rest Inn. (Jens Larson). He had in his bait box fifteen frogs, two half grown ones being *Rana p. burnsi*. . . . We next started for Mr. Carl Holm's place. We stopped in a meadow where fringed gentian, *Lobelia syphilitica*, smartweed, *Gerardia paupercula* and other plants grew. Here we took one *Rana p. burnsi* and twenty *Rana p. pipiens*. Some of these *Rana p. burnsi* are brown, others plain green. Mr. Holm said he had found little meadow frogs without spots. . . .

We went to South Florida sloughs. Here we found 6 or 7 *Rana p. burnsi*. We must have seen 200 frogs. The ratio of *Rana p. burnsi* to *Rana p. pipiens* was 1 to 28 or 1 to 35. These were in sedgy grass. Most of the frogs are doubtless in the heavier and taller grasses. Most of the *Rana p. burnsi* were half grown. We took two large males in quick succession. One was uniform green and the other brown. The next day, when we opened their can, they were still of the same colors. . . .

We went to Sam Dilly's at Old Mill Inn two miles from New London. He had in his bait stock one *Rana p. burnsi*. *Rana p. burnsi* is a beautiful frog, brown or green when young, and equally variable when grown.

A problematical form.

Mottled Meadow Frog. Kandiyohi Meadow Frog.

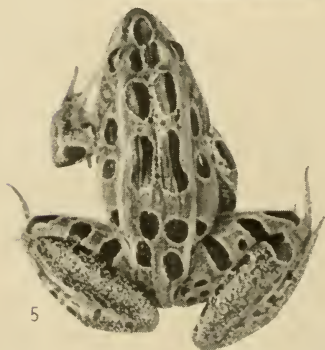
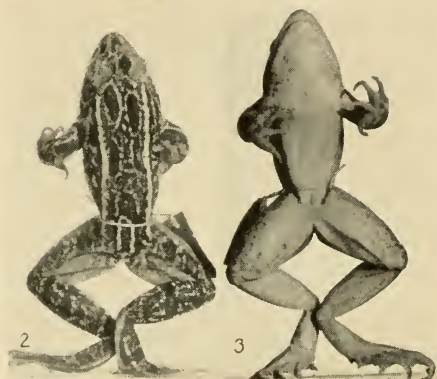


PLATE LXXIII. ($\times \frac{1}{2}$). 1, 2, 3. Males. Weed's paratypes. 4, 5. Intermediate forms.

Rana pipiens kandiyohi (Weed).

Range: Southwestern Minnesota and adjoining portion of South Dakota.

Habitat: Open meadows and pastures.

Size: About same as the common meadow frog (*Rana p. pipiens*).

General appearance: This is a meadow frog with the dark spots overlaid with dark irregular mottling and tracery. This mottling is carried down on the legs and feet and well down on the sides, fading gradually into the white of the lower surfaces. Sometimes the mottling is as dark as the spots, at other times it is lighter. The glandular ridges or folds along the back are similar to those in the other meadow frogs.

Structure: Web of foot variable.

Voice: To A. C. Weed who first described these frogs, the note is quite distinct—is a croak that “might be represented by grinding two stones together under considerable pressure.”

Breeding: Nothing recorded.

Notes: In August 1930, we searched meadows and borders of lakes and small streams

from Spicer, Minn., northward to Rainy Lake, westward to Walhalla, N. D., and then southward and eastward over a different route to St. Paul, Minn. We saw many, many meadow frogs of all sizes with a wide variation in their spotting, but found only intermediate forms approaching in small part the typical *R. p. kandiyohi*. Some had few spots, even down to 3 or 4 small ones on the back, others had many. Some had long narrow spots, others round ones. In some, the spots were very weakly outlined, so that they were much less conspicuous. In some there were many dark specks and dashes between the spots. In one large frog the bars on the tibia were entirely lacking, being replaced by many light specks on a dark ground. Along a half mile of a canal at one end of Green Lake at Spicer, Minn., we saw 200-300 small meadow frogs. This was in the center of Kandiyohi county.

Several years ago, the living specimens of Weed were in a large jar on the platform where one of the authors was presiding. They were more or less continually croaking, and at that time we distinctly said they were like *Rana pipiens* in voice. At the same time, we recalled that rarely one would find in different lots of meadow frogs an unspotted one, *Rana p. burnsi*, or a mottled one, *Rana p. kandiyohi*, and therefore we aligned ourselves more or less with the group which questioned whether these two species or subspecies were worthy of specific designation. Since our trip (Aug., 1930) to Kandiyohi County, and other parts of Minnesota, we have to grant that a collector cannot go out in other parts of the meadow frog's range and deliberately find these color phases, as we did there. These two forms of Weed become therefore increasingly interesting and worthy of considerable study, and possibly one of the two may be as worthy of designation as some other subspecies of frogs which most herpetologists accept. A beautiful genetical problem for some Minnesota naturalist!

"Two lines of investigation seem necessary if these frogs are to be rescued from their present doubtful position and either placed in their proper relation to other known forms or else eased back into synonymy. In the first place, careful collecting should be done in the region where these frogs are found, in order to find out their relation to other species in habitat and numbers. This field work should be supplemented by controlled breeding experiments to determine the method of inheritance of the color characteristics both in pure strains and in hybrids. It is hoped that someone may be found who may have the time and equipment to do this work. It is a problem which appears simple on the surface but which would probably bring in many related questions and should have an important effect on the solution of many problems of nomenclature."—(Alfred C. Weed. *Turtlox News*. June, 1930, Vol. 8, No. 6, pp. 43-44).

The Western Frog. Western Spotted Frog. Pacific Frog.

PLATE LXXIV. 1, 3. Females ($\times \frac{1}{2}$). 2. Male ($\times \frac{1}{2}$). 4. Male ($\times \frac{1}{5}$).

Rana pretiosa pretiosa
(Baird and Girard).

Range: Northern California to Southeastern Alaska, and east to Montana and western Wyoming.

Habitat: Aquatic. In pools and marshes along permanent streams, in lakes or springs of mountainous sections.

Size: Adults, 2 $\frac{4}{5}$ –3 $\frac{4}{5}$ inches. (Males, 45–75 mm. Females, 46–95 mm.). (These measurements are of *R. p. pretiosa* and *R. p. luteiventris*). We doubt if males and females under 50 mm. breed to any great extent.

General appearance: This is a medium-sized frog, light or dark brown with finely roughened skin on the dorsal parts; the back and top of head have inky black spots, which at times may be very large and irregular. Occasionally these dark spots have light centers like the ones in *R. a. draytonii*. There is a light streak on the upper jaw. It usually has a prominent dorsolateral fold, but in some even this disappears. Sometimes the throat and sometimes the entire under parts are spotted. The under parts are yellowish to salmon red, clouded or marbled with gray. The limbs have cross-



bars. Preserved specimens may approach the appearance of *R. cantabrigensis*, or with few or no spots may suggest the green frog, *R. clamitans*.

Structure: Male with thumb enlarged and webs of hind foot tending to become convex as in *Rana sylvatica*; tip of fourth toe free; no dark cheek patches; no red on sides.

Voice: The male is without lateral vocal sacs.

Breeding: They breed from March to July. The egg mass is about a pint in bulk. The egg is $1/12$ inch (2 mm.), the outer jelly envelope $2/5$ – $3/5$ inch (10–14 mm.) (adapted from Dickerson, 1906, p. 219.) The envelopes are large and the eggs appear far apart. The tadpoles, $2\ 1/4$ – $2\ 4/5$ inches (56–70 mm.) with tooth ridges $3/3$, transform from June to August at $5/8$ – $7/8$ inch (16–23 mm.).

Notes: "Common along streams, but nowhere plentiful. A stupid frog, easily caught; neither a strong jumper nor a fast swimmer. The salmon color of the underside is absent from the newly transformed adult; it increases in extent and brilliancy with increase in size, occasionally overspreading nearly the entire under surface in a large adult. About one hundred specimens secured."—(Frank N. Blanchard, 1921, p. 6).

"There would seem to be little doubt that the mature and transforming tadpoles taken at Brent's lake on July 1, with an average body length for all of 21.98 mm., and for the eleven larger specimens of 27.63 mm., belonged to the brood of the preceding year and had wintered over as tadpoles, and consequently were ready to begin transformation earlier in the summer than those nearer the coast (Puget Sound) which go through their metamorphosis in the same year in which they are hatched."—(E. B. S. Logier, 1932, p. 324).

Nevada Spotted Frog.

Rana pretiosa luteiventris Thompson.

(In the present state of our knowledge we feel inclined to follow Boulenger in combining *R. p. pretiosa* and *R. p. luteiventris*).

Range: Southeastern Washington, eastern Oregon, northeastern California, northeastern Nevada, and probably other interior parts.

Habitat: Irrigation ditches. Is quite aquatic.

Size: See *R. p. pretiosa*. $1\ 3/4$ – $3\ 1/2$ inches (44–87 mm.).

General appearance: Like *R. p. pretiosa*.

Structure: Tubercle at base of fourth toe absent in the mature frogs. Palmar tubercle lacking or less distinct than in *R. p. pretiosa*.

Voice: Not on record.

Breeding: The tadpoles are quite large, 4 inches (101 mm.), the tooth ridges $2/3$.

Mink-frog. Northern Frog. Hoosier Frog.
Rocky Mountain Frog.



PLATE LXXV. 1. Female ($\times \frac{2}{3}$). 2. Male ($\times \frac{1}{2}$). 3. Egg mass ($\times \frac{1}{5}$). 4. Head of male ($\times \frac{1}{2}$). 5. Male ($\times \frac{1}{2}$). 6. Male ($\times \frac{2}{3}$).

Rana septentrionalis Baird.

Range: Northern New England and northern New York (south to Petersboro, G. S. Miller, Jr.), west to Minnesota, north in Canada to Hudson Bay.

Habitat: This is an aquatic frog, found in peaty or sphagnum lakes or ponds or in inlets or outlets of such lakes or ponds, particularly where water lilies are growing.

Size: Adults, 1 7/8-3 inches. (Males, 48-71 mm. Females, 48-76 mm.).

General appearance: This frog is a small representative of the bullfrog—green frog group. The sides are heavily mottled, the rear of the femur heavily reticulated. The back is buffy or brownish olive, almost uniform, or mottled with large dark areas set off by a tracery of light lines around or amongst them, or spotted with widely separated spots. Sometimes the forward part of the back is uniform and quite green, and the rear part spotted (much like some *R. onca*). The upper jaw is green. The legs are spotted or with a few bars. The mottling on the femur is

suggestive of the *R. virgatipes*—*R. grylio* group. In young specimens the sides may be speckled and the throats mottled. In the largest males, the entire under parts are maize yellow.

Structure: No lateral folds, or folds interrupted; webs large, but leaving one joint of fourth toe free; head narrow, snout pointed; eyes close together; tympanum conspicuous, in males much larger than the eye.

Voice: One call is like the sound of driving a long nail into a heavy timber with a hammer. Another thought it like the "shucking" of a loose wheel on a lumber wagon. S. C. Bishop described it as "cut-cut with sometimes a 'burred' gh-r-r."

Breeding: They breed from June 24 to July 30 or possibly August 16, the crest coming in July. The egg mass is a plinth, 3–5 inches (75–125 mm.) by 2 inches (50 mm.) thick. The egg is brown to black and buff to yellow, the envelope $\frac{1}{4}$ inch (6–7 mm.) becoming $\frac{5}{16}$ – $\frac{3}{8}$ inch (8–9 mm.) as development proceeds. The olive tadpole is large, 4 inches (99 mm.), its tail elongate with acute tip. The tooth ridges are $\frac{2}{3}$. After a tadpole period of 1 year or slightly more, they transform from June 24 to August 30, the bulk in July, at $1\frac{1}{6}$ – $1\frac{3}{5}$ inches (29–40 mm.).

Notes: On July 16 and 17, 1913. Otter Lake, Canada. . . . All along the north edge of the lake were white water lilies, yellow spatterdocks and water shields. These three made a perfect carpet on the water's surface. On these plants during the day the frogs rested. . . . Another habitat was a beaver lake where *Cassandra* and all the associated heath-like plants grew. In Fletcher Lake, Sept. 1, we found them in the shallow sandy shores amongst pipeworts (*Eriocaulon articulatum*).

Mr. S. C. Bishop on July 13, 1923, at Adirondack Lodge "found one small lot of eggs (12) on the sandy bottom of the lake in about 8 inches of water. They were being eaten by a newt when found. Either the newt may have carried them there or they may have been a few laid by a female which laid a few before the main ovulation. On July 13 p. m., day mostly bright and windy. Found three egg masses of the mink frog (*Rana septentrionalis* Baird) fastened to the stems of the yellow cow lilies. They were attached 8, 12 and 18 inches below the surface in plinth masses from 4 to $5\frac{1}{2}$ inches in largest diameter. The lilies are 4–6 rods from the shore in 6–8 feet of water. Newts very common in the lake are the enemies of the eggs and embryos. In the mass of hatching young, one newt was found in the middle of the mass. In attempting to photograph eggs in lake, newts came and attempted to crawl into the mass."

Southern Leopard Frog. Southern Meadow Frog. Spring Frog. Spotted Frog. Water Frog. Shad Frog.

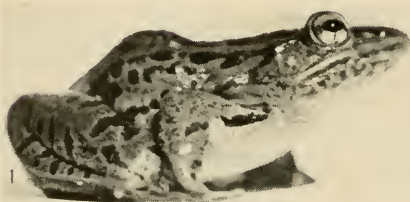


PLATE LXXVI. 1. Male ($\times \frac{2}{3}$). 2. Female ($\times \frac{2}{3}$). 3. Female ($\times \frac{3}{5}$).

Rana sphenocephala (Cope).

Range: Southeastern States, north along the coast to Virginia or New Jersey.

Habitat: Ponds, runs, canals, river swamps and overflowed roads and ditches. In a large swamp, it is ideally on the edge of cypress ponds and bays or small pools at an island's edge.

Size: Adults, 2-3 $\frac{1}{4}$ inches. (Males, 49-78 mm. Females, 53-82 mm.).

General appearance: It is like the meadow frog *R. pipiens*, but usually with a clear cut, distinct white spot in the middle of the ear drum. It is an alert, active, long-legged and long-snouted spotted frog.

Structure: Head longer in proportion to body than in *R. pipiens*; snout acuminate or pointed; fourth toe shorter than in *R. pipiens* and more regularly placed; less spots and more vermiculations on sides of *R. sphenocephala*; dusky fleckings on the under parts more common in *R. sphenocephala*; lower lip with dark spots; vocal sacs on either side between arm and tympanum.

Voice: The call is 3, 4 or 5 guttural croaks with two or three clucks afterwards. The process may occupy 5 or 6 seconds. They are shy, croak at night, and even a big chorus is quickly stopped as one approaches the pond. They may croak from the surface, beneath the surface or from perches on logs, sticks or around the bases of bushes.

Breeding: They breed from February to December, the crest coming from April to August. The egg mass is a plinth, 5-6 inches (125-150 mm.) wide, 1-2 inches deep (25-50 mm.), attached to stems of plants or to sticks, submerged. The egg is 1/16 inch (1.6 mm.), the envelopes, 1/8 inch (3.2 mm.), 1/5 inch (5.4 mm.). The tadpole is large, 3 inches (74 mm.), the tail with conspicuous black blotches as transformation approaches. The tooth ridges are 2/3 or 3/3. After a tadpole period of 67 to 86 days, they transform from April to October at 4/5-1 1/3 inches (20-33 mm.).

Notes: April 29, 1921. Okefinokee Swamp, Ga. Noah Lee took me to where he had found frog's eggs. They were about 8 feet from the edge of the pond in water 4-6 inches deep. . . . We found two more isolated masses each at or just below the surface and encircling lizards' tail (*Saururus*) which is now in bloom. The water on the surface was 90°. Of the croaking position, we recorded on April 23, 1921 that male *Rana sphenoccephala* lie on the surface when croaking or are amongst pickerel weed stems. The rear of the body is usually sprawled out and may be at the surface or submerged. The head and upper back are usually emergent. At times they may croak from the edge of a pond like *R. pipiens* or croak beneath the surface or lie amongst drift wood.

This species began croaking and breeding early in the season long before we arrived in the swamp in April. The earlier choruses come by day as well as at night. As the season advances the later breeders may be heard only in late morning before dawn except for rare periods in day time before a storm passes or after its passage.

September 11, 1929. About dusk, we stopped near Lyons, Indiana, near the home of Gless J. Deckard and heard many meadow frogs in a pond back of his place. We found many of them at the edge of the pond in grass or in little depressions. At times, though not croaking, they kept their sacs inflated. They have more pointed snouts than our northern meadow frog and all had light centers to the tympana. . . . September 12, 1929. We went on to Olney, Ill., driving on the 'slab-road,' about a mile south of the town lights. Here we found a pond beside the road, and lo and behold there were about ten egg complements of meadow frogs.

Wood-frog. Wood Frog.

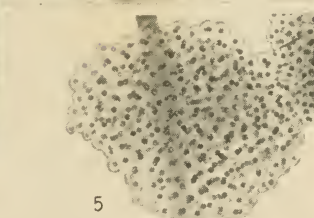


PLATE LXXVII. 1. Female ($\times \frac{2}{3}$). 2. Foot of male with convex webs ($\times 1$). 3. Female ($\times \frac{3}{5}$). 4. Foot of female with concave webs ($\times 1$). 5. Egg mass, spherical in shape ($\times \frac{1}{2}$). 6. Male ($\times \frac{2}{3}$).

Rana sylvatica Le Conte.

Range: Quebec and Nova Scotia to S. Carolina, westward to the Great Plains (Stejneger and Barbour, 1923, p. 37).

Habitat: Wooded areas. Breeds in leaf-laden ponds and transient pools of wooded districts. Hibernates in logs, stumps, under stones in wooded ravines, or beneath boards near woods, never in the water.

Size: Adults, 1 $\frac{3}{8}$ –3 $\frac{1}{3}$ inches. (Males, 34–60 mm. Females, 34–68 mm.). One female from Linville, N. C. (No. 55159 in U. S. Nat. Mus.) measures 82.5 mm.

General appearance: The wood-frog is medium in size, either light or reddish brown above, with a darker brown streak or mask on either side of the head and a dark line from the eye to the tip of the snout. There is a light line along the upper jaw continuing to the shoulder. Underneath, it is a glistening white with a dark bar on the upper arm. The legs are long, marked with dark cross bars. It has prominent dor-

lateral folds. When caught in the breeding pools, the body seems broad and flat and rather soft, and dark in color, but when caught later in the woods, the form is compact, more slender, and the frog has a very alert appearance. Some individuals have inky dashes on the sides and occasionally on the back.

Structure: Head pointed; legs long; webs of hind feet of males very convex at breeding season; hind leg long (.53-.62 in length of body while .62-.74 in *R. cantabrigensis*).

Voice: The wood-frog's note is very short, a sharp snappy *clack*. At times 2, 4, or 6 notes are given in rapid succession; and when close at hand, they sound high and grating in character. It can be heard only a short distance from the pond. In chorus, it is more of a rattle than with any other frogs. It has often been likened to the "quacking" of ducks.

Breeding: They breed from March 19 to April 30, at a temperature of about 50° F. The egg mass is globose, 2 1/2-4 inches (62-100 mm.) in diameter, the individual eggs appearing larger than in *R. pipiens*, freer and the outer envelope of each egg keeping its spherical form. The egg is 1/14-1/10 inch (1.8-2.4 mm.), the inner envelope faint, 1/7-1/4 inch (3.6-5.8 mm.), the outer, distinct 1/5-2/5 inch (5.2-9.4 mm.). The egg complement is 2,000-3,000. The deep olive tadpole is medium, 2 inches (49.8 mm.), its tail long with tip acuminate and dorsal crest very high. The tooth ridges are 3/4. After a tadpole period of 44 to 85 days, they transform from June 8 to August 1, mostly before July 15 at 5/8-3/4 inch (16-18 mm.).

Notes: April 6, 1908. Southeast Slaughter House Pond, Ithaca, N. Y. As I approached the pond, I heard the greatest chorus of low grating croaks I ever recorded from wood-frogs. This was at 11:30 a. m. From the south I crawled upon them (bellywise using elbows to move along slowly). At times, I used my opera glasses. In this way, I was able to reach the edge of pond without disturbing croakers. In this pond were at least 200 males croaking. . . . Where yesterday there was only one *Rana sylvatica* bunch, there were now 17 bunches of eggs laid April 5-6. When I arose they all disappeared simultaneously. To go through the pond one would little realize 200 males were there, to say nothing of the females.

Since many of the egg masses are laid near the edges of shallow ponds, many egg masses are left high and dry. A far more serious source of danger is freezing. Most of the bunches are laid from 1/2-2 inches beneath the water's surface. In many instances, long before the hatching period approaches, the tops of these complements appear at the surface because of the reduction of water level by rapid evaporation.

Mexican Frog.

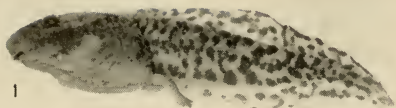
PLATE LXXVIII. ($\times \frac{1}{2}$). 1. Tadpole. 2, 3. Adults.

Rana tarahumarae Boulenger.

Range: "Sierra Tarahumarae, N. W. Mexico, about 3000 ft."—(Boulenger. 1919, p. 415).

"On June 18, 1931, near Pena Blanca Springs, Santa Cruz County, Arizona, the writer was fortunate in finding a colony of the Mexican frog, *Rana tarahumarae* Boulenger. A specimen forwarded to the National Museum was kindly examined by Dr. Remington Kellogg, who pronounced it to be that species. Previously, these frogs were reported only from the Tarahumara Mountains, Chihuahua, Mexico. In Arizona, they were found at an elevation of approximately 4,000 feet in a locality only two miles from the international boundary."—(Berry Campbell. 1931, p. 164).

Habitat: "The colony was clustered around a series of pot-holes in a canyon, . . . and no running water could be found in the region. Besides the twenty or so adults seen in these pot-holes, a group of probably half that number was found in an old tumbled-in mine which had filled with water."—(Campbell, p. 164).



Size: Adults, 2 $1\frac{1}{3}$ –4 $1\frac{1}{2}$ inches. (58–113 mm.). “The resemblance of the adults to *Rana boylei* is very noticeable, but the size is distinctive—the three specimens on hand measuring 81, 91 and 113 mm. (head and body).”—(Campbell, p. 164).

Color: (preserved specimens) Dorsum deep grayish olive, a deep olive or even plumbeous black or blackish brown (3). Fore limb and hind limb interspaces grayish olive or citrine drab. Blackish cross bands show in the smallest specimen, one across femur just back of groin and three more before the knee on which is a black spot. The first or second cross band on the tibia may go completely across. Subsequent ones are broken. There are two cross bands on tarsus and two or three on foot. The smallest and intermediate specimens are clear below but the largest (113 mm.) has a very dusky throat and dusky venter in general.

Structure: Head broader than long, depressed; rounded snout; skin smooth or back with small pustules; curved glandular fold, eye to shoulder.—(Adapted from Boulenger).

The male has the swollen thumb with a slight tendency toward a diagonal oblique depression across its middle like *R. boylei* subspecies.

I. *Rana tarahumarae*. Adults larger, 1 $\frac{4}{5}$ or 2 $1\frac{1}{3}$ –4 $1\frac{1}{2}$ inches (45 or 58–113 mm.); tibia shorter, 1.86–2 in length; hind leg shorter, .65–.69 in length; throat and lower jaw uniform or cloudy; no outer metatarsal tubercle; no stripe on upper jaw. “Heels not overlapping.”—(Boulenger).

II. *Rana boylei* (3 subspecies). Adults smaller, 1 $\frac{3}{5}$ –3 $\frac{1}{3}$ inches (39 or 40–84 mm.); tibia longer, 1.61–1.87 in length; hind leg longer, .57–.66 in length; throat and lower jaw more or less spotted; outer metatarsal tubercle present; stripe on upper jaw present or obscure. “Heels overlapping.”—(Boulenger).

Breeding: “The breeding season is evidently after the heavy summer rains which begin in July.”—(Campbell. 1931, p. 164).

The tadpole is quite large 3 $1\frac{1}{2}$ –4 inches (88–101 mm.) and the tooth ridges are $\frac{5}{3}$, $\frac{4}{3}$. (Preserved tadpoles.) The venter is pigmented, belly whitish. The venter has a bluish (looks to be a broad blood vessel) median broad band from pectoral region to the developing hind legs. This band has 3 or 4 regular pairs of lateral branches. The intestine does not show through the skin. The tail is elongate, its tip pointed (not rounded as in some *R. boylei*). The entire tail and body, except venter and throat, are *heavily spotted with prominent dark spots*. B. Campbell found them transforming June 18, 1931.

Notes: On Sept. 22, 1931, Mr. Berry Campbell writes me as follows: “Though I got very few adults, I collected about 10 larvae . . . The larvae have never been described. . . The adults are very much like *Rana boylei* but the tadpoles, I think, do not show such close relationship. . . .”

Sphagnum-frog. Carpenter Frog. Cope's Frog.



PLATE LXXIX. 1, 3. Females ($\times \frac{4}{5}$). 2, 5. Males ($\times \frac{4}{5}$). 4. Male croaking ($\times \frac{1}{3}$).

Rana virgatipes Cope.

Range: New Jersey to Okefinokee Swamp, Ga.

Habitat: It may be in the sphagnum edge of open ponds, in sphagnum mats in deeper parts of ponds or lakes, in wooded edges of some of the coastal rivers, in branch swamps of the southeast, in wooded inlets or outlets of open ponds, cypress bays or strands of islands in southern swamps, or at times in the open water-lily prairie.

Size: Adults, 1 $\frac{5}{8}$ –2 $\frac{5}{8}$ inches. (Males, 41–63 mm. Females, 41–66 mm.).

General appearance: This small frog has a long, narrow head, back brownish with four yellowish or golden-brown, longitudinal stripes. The under parts are yellowish white with dark brown or black spots. The rear of the femur has alternating dark and light stripes. The sides also are marked with blackish spots.

Structure: Tympana enlarged in the males, but not so striking as in *Rana grylio*, *Rana catesbeiana*, *Rana clamitans* or *Rana onca*, (except in very old males), nor is the thumb quite as large proportionally; no dermal folds; two joints of fourth toe free;

males with vocal pouch on either side; these being perfectly round vesicles when inflated, and the throat not inflating.

Voice: The call is like the blow of a hammer, usually repeated 3-6 times in rapid succession, or like wood choppers.

Breeding: They breed from late April to mid-August. The egg-mass is a plinth 3-4 inches (75-100 mm.) x 1 1/2 inches (38 mm.), or it may be globular. The complement is small, 200-600 eggs. The black and creamy white eggs are large and far apart. The egg is 1/16 inch (1.5-1.8 mm.), the envelope 1/8-1/4 inch (3.8-6.9 mm.). The tadpole is large, 3 5/8 inches (92 mm.), dark in color with a few black spots, its tail grayish with a row of large spots in the upper crest. The tooth ridges are 2/3 or 1/3. After a tadpole period of 1 year, they transform in early spring at 15/16-1 1/4 inches (23-31 mm.).

Notes: On May 22-23, 1924, we heard a few males croaking on the south side of the west point into the lake at Lakehurst, N. J. It was noon and the sun was shining. Here in the sphagnum-heath edge, we caught 4 adults, two females and two males. As we waded along we would see them sometimes wholly out of water or at the lake's edge. Usually they leaped into the water and hid under the vegetation mat or quickly came up under a water-lily leaf or swam some distance and then poked out their heads. Most of the males were out in the deeper water.

June 8, 1929. Raining . . . The frogs were in mid-lake in the matted vegetation. The boys, Everett and Whittemore Shinn and R. D. Anderson, went out in the canoe, and caught some for us with a long handled dip net.

In coloration *R. virgatipes* looks most like *R. grylio*. In adult size it is more like *R. septentrionalis* but smaller or is possibly like a small *R. catesbeiana*. At Lakehurst Lake it reminds one of the water prairie form, *R. grylio*; in the sphagnum strands and thickets of the Okefinokee it reminds me of the peat lake species of Canada or beaver-lake thicket form of the Adirondacks, namely, *R. septentrionalis*. In egg mass it is most like *R. septentrionalis*, but in individual eggs unlike *R. septentrionalis*, *R. clamitans* and *R. grylio* because it has no inner jelly envelope. The individual eggs are more like the eggs of the film species *R. catesbeiana*, but the jelly is firmer. The tadpole reminds one most of *R. grylio* in coloration, but it is more of the *R. clamitans* type. Like all of the *R. clamitans* and *R. catesbeiana* type it winters over as a tadpole. It transforms at a size near that of *R. clamitans* and may have a larger tadpole than that species. Therein it approaches *R. catesbeiana*, *R. grylio* and *R. septentrionalis*.

Narrow Mouth Frog. Narrow Mouth Toad.

Narrow-mouthed Frog.
Narrow-mouthed Toad.
Nebulous Toad. Tooth-
less Frog. Rainy Day
Frog. Rain Frog. Frog-
toad. Carolina Tree Frog.
Carolina Toad.

PLATE LXXX. ($\times 1$). 1, 2,
6, 7. Females. 3. Male croak-
ing. 4. Tadpole. 5. Egg mass.

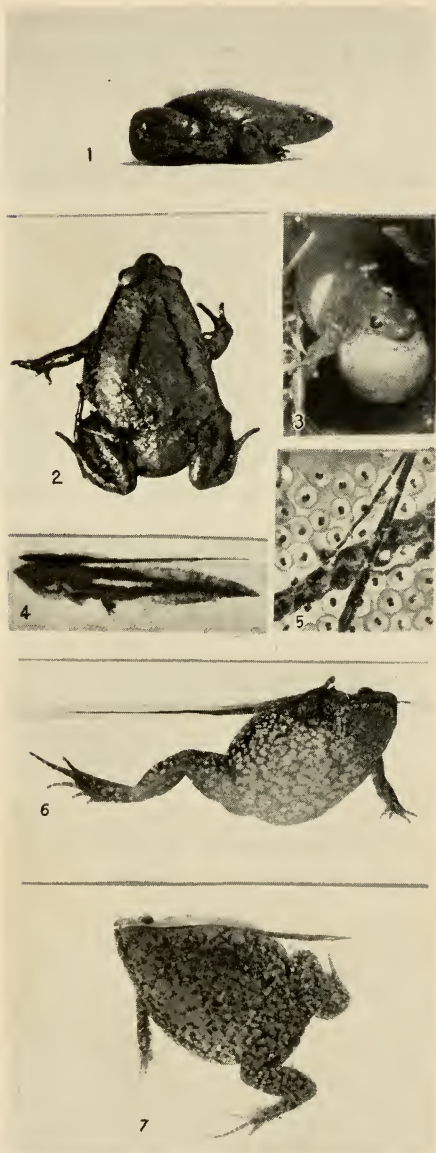
Gastrophryne carolinensis
(Holbrook).

Range: Virginia to Florida
to Texas. North to Missouri
and southern Indiana.

Habitat: Nocturnal, a lover
of rain, cover and moist
situations. It is a subter-
ranean species. Hides in de-
caying logs or beneath them
or under haycocks or other
shelter.

Size: Adults, $4\frac{4}{5}$ – $1\frac{2}{5}$
inches. (Males, 20–30 mm.
Females, 22–36 mm.).

General appearance: This
frog is small, dark colored, and
relatively smooth skinned.
A fold of skin extends
across the head just back of
the eye. The head is small,
the snout pointed. As one
child remarked, its head
looks like a tiny turtle head.
The fold of skin accentuates
this. There is no tympanum.
The hind legs are propor-
tionally stout. The fingers
and toes are without webs.
The back may be black,



brown or gray, the under parts, dusky gray or brown speckled or mottled with light.

Structure: Skin usually smooth or finely tuberculate; upper jaw projecting beyond the lower; a fold of skin extending from one arm insertion to eyes, thence to other arm insertion; tongue broad, only caudal border free; inner metatarsal tubercle present.

Voice: The call is a bleating *baa* that might well deceive anyone. They usually call from the water with rear parts submerged and fore feet planted on the bank or on some other support such as trash on water's surface. Occasionally they are out on the bank or in a grassy tussock. The throat swells out like the light bubble of a toad or spadefoot. The call lasts 1.5–2 seconds, perhaps 20 calls in 30 seconds.

Breeding: They breed from May 1 to September 1. The egg mass is a surface film, or smaller packets of 10–90 eggs, the complement 850 eggs. The black and white eggs are firm and distinct like glass marbles, making a fine mosaic, the envelope a truncated sphere, flat above, the envelope $1/9$ – $1/6$ inch (2.8–4 mm.), the egg $1/25$ – $1/20$ inch (1–1.2 mm.). The tadpole is small, 1 inch (26.5 mm.), flat, wide, and elliptical in shape, the snout truncate, the dorsal and ventral sides of the head flattened, and the eyes visible from the ventral aspect. The tail is medium, obtuse or rounded, sometimes with a black tip. The spiracle is median, closely associated with the anus, and its separation apparent as the hind legs appear. There are no teeth, no horny mandibles, no papillae. After a tadpole period of 20 to 70 days, they transform from mid-June to mid-October, at $5/16$ – $1/2$ inch (8.5–12 mm.).

Notes: May 22, 1921. Okefinokee Swamp, Ga. In the ditches were *Gastrophryne* eggs. Each egg stands out distinctly. We found the water blackish, trashy, and oily with floating packets of eggs. Some masses were 1 x 1 inch (25 x 25 mm.) in diameter; others 2 x 1 inches (50 x 25 mm.); others 2 x 2 inches (50 x 50 mm.); some round masses, others square. Each jelly envelope abuts that of the next in pentagonal or hexagonal fashion. In proper light a mass of eggs makes a mosaic. Some egg masses along banks in weeds may be 1 foot 10 inches (550 mm.) long and 3 or 4 inches (75 or 100 mm.) wide. One mass in the middle of ditch was amongst chips and was 4 x 7 inches (100 x 175 mm.). There are few such in mid-pond. We believe they lay large masses along the edges or amongst the brush, and the wind scatters them.

In a clean pond (20 x 3 feet) along its edges in amongst grass, was one packet of eggs, 100–125. They are brown and yellowish, more eggs in a mass than in a film of *Hyla versicolor*. Insects get into the fresh masses.

Texas Narrow-mouthed Toad. Texas

Toothless Frog.

PLATE LXXXI. 1, 7. Females ($\times 1\frac{1}{4}$). 2, 6. Males ($\times 1\frac{1}{4}$). 3. Eggs ($\times \frac{2}{3}$). 4, 5. Transforming frogs ($\times 1$).

Gastrophryne texensis (Girard).

Range: East-central, central, and southern Texas. (Baylor Bull, 1915, p. 47). We secured one tadpole in western Trans-Pecos, Texas. Now known from Texas to Kansas (Kellogg, Smith, *et al*).

Habitat: Nocturnal in habit. Seek protection under logs or dead stumps sunken in the ground; in the far southern tip under fallen trunks of Spanish bayonet. Breed in ponds, roadside ditches, or temporary rain pools.

Size: Adults, $\frac{4}{5}$ – $1\frac{1}{5}$ inches. (Males, 20–28 mm. Females, 19–29.5 mm.).

General appearance: This is a small, usually dark colored, smooth skinned "Frog-toad" with small pointed, flattened head. The under parts are uniformly white, the head and body depressed, the limbs slender in appearance. The back is grayish olive with black spots, the pectoral region and front half of the breast, whitish with a greenish cast. The eyes are small and bead-like.

Structure: Body more depressed than in *G. carolinensis*.



linensis; head appearing more pointed than in *G. carolinensis*, because of depressed body; limbs more slender in *G. texensis*.

Voice: It begins its call with a pleasant little whistle and then runs into its bleat. It opens something like *whew*.

June 15, 1930, Beeville, Texas, 8:30-9:30 p. m. We finally heard one or two *Gastrophryne texensis*, a much lower and less carrying note than that of *G. carolinensis*.

Breeding: They breed from March 15 to September in heavy rain periods. The egg-mass is a surface film, the complement 645, the eggs, black and white. The egg is $1/30$ - $1/25$ inch (0.8-0.9 mm.), the envelope $1/9$ - $1/8$ inch (2.8-3 mm.), loose and irregular, possibly merging in the film mass. The grayish olive tadpole is small, $15/16$ inch (23 mm.), flat and wide, the tail tip black, the eye just visible from the ventral aspect. There are no teeth, no horny mandibles, and no papillae. After a tadpole period of 30 to 50 days, they transform from April 15 to October at $2/5$ - $1/2$ inch (10-12 mm.).

Notes: March 24, 1925. Beeville, Tex. In a roadside ditch, *Gastrophryne* are at the edge, above the water, croaking. We approached one slowly, didn't see him croak, but the instant the light was put on him, he began to crawl up the bank and through the grass, mouse-like, going very fast.

July 10, 1925. Fort Davis Mountains. In a large permanent pond two miles south of Fort Davis, we were much surprised to find one lone narrow-mouthed toad tadpole, a mature one. Strecker credits the Texas narrow-mouth to East-Central, Central and Southern Texas. We know of no other record of this *Gastrophryne* this far westward.



Mitchell's Narrow-mouthed Toad.

Gastrophryne areolata (Strecker).

Range: Southeastern Texas. Known only from Victoria and Calhoun counties (Strecker, 1915, p. 47).

Habitat: Under logs and similar shelter.

Size: Adults, $7/8$ – $1\ 1/5$ inches. (Males, 24–28 mm. Females, 23–30 mm.). (From 5 accessions of 14 specimens in U. S. Nat. Mus.).

General appearance: It is like *Gastrophryne carolinensis* but the back is areolated, the posterior parts even pustular (in alcohol). One is light gray with darker markings or marblings which are heaviest in the dorsal region. The limbs are heavily marked. Another is dark, the limbs marked with blotches of brownish olive, a dark line from orbit to orbit along the muzzle, and a V-shaped mark between the orbits. No dark line extends along the sides as in *G. carolinensis*. (Data from Strecker, 1909, pp. 118–119.).

Structure: Smaller than *G. carolinensis*; body stout, more uniform in width than *G. carolinensis*; muzzle shorter; hind limbs short; hind foot unusually short; inner sole tubercle large. (Data from Strecker, 1909, p. 119.).

Voice: No published records.

Breeding: No published records.

Notes: The pustulate or areolate character of *G. areolata* does not impress us as noteworthy, when one remembers the pustulate character in the posterior region or whole dorsum of some individual *G. carolinensis* in the southeast. In fact we have seen some there more pustular than any specimen of *G. areolata* revealed to date.

A debatable form.

Taylor's Toad.

PLATE LXXXII. 1, 3. Female ($\times 1\frac{1}{4}$). 2. Male ($\times 1\frac{1}{4}$).

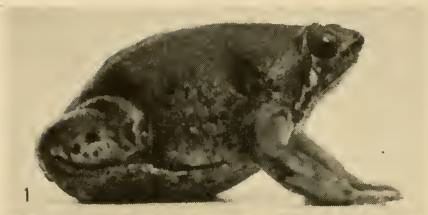
Hypopachus cuneus Cope.

Range: Southern Texas. San Diego and Brownsville. Kingsville (Reed), Edinburg (Muliak and Swanton) and other localities.

Habitat: Subterranean form.

Size: Adults, 1-1 $\frac{5}{8}$ inches. (Males, smaller, 25-37.5 mm. Females, 29-41 mm.).

General appearance: This narrow-mouthed toad, though small, is a large edition of the common narrow-mouthed toads. The skin of the back is smooth, loose and leathery. The fold across the top of the head may be prominent when the head is withdrawn, or almost lacking when head is extended. The head can be withdrawn till it almost disappears as the snout reaches the line of the fold. They certainly have turtle necks in this respect. The conspicuous mark is the light yellow or orange thread-stripe down mid-back, the back being a greenish brown or olive color. One irregular line of black dots may extend from mid-dorsal line near head to upper groin on either side. The most prominent and apparently constant mark in all ages is the broad oblique white line ex-



tending from the eye downward halfway from the angle of mouth to the axilla. This line is rendered more conspicuous by the black spots bordering it above and below. The belly is mottled in two shades of gray. There is a white thread-like line extending the length of the lower surface with a branch going off to each arm. The sides, groin, rear of femur and sides of legs are heavily marked with inky spots. There is a cinnamon, fawn or orange tinge in the groin, on the femur and upper arm. The eyes are prominent and bead-like.

Structure: Toes and fingers slender, feet with very short webs; tubercles under joints of toes prominent; inner and outer sole tubercles large, each with a cutting edge; legs short; one of the striking things is the short 5th toe in contrast with the 3rd toe.

Voice: Not on record.

Breeding: They breed from March to September in periods of heavy rain. The eggs are not on record. The tadpole is small, 1 1/12–1 1/5 inches (27–30 mm.), wide and flat like *Gastrophryne*. It has a broad mid-dorsal band of dark grayish olive, with the edges scalloped and, as transformation approaches, a light line bordered with black from the eye to the arm. There are no teeth, no horny mandibles, and no papillae. They transform from April to October, at 2/5–1/2 inch (10–12 mm.).

Notes: April 22, 1925. San Benito, Texas. We found on the east edge of a fine blue water-lily pond one *Hypopachus* just transformed. It was in the wet sedges where transformed *B. valliceps* were hopping about and *Pseudacris* were transforming. We found two or three more, but no mature tadpoles in this pond. One had a long tail and a dark dorsal band with concave scalloped edges. In a fully transformed one, the tail stump looks “bronzy.” The under parts are specked whitish and gray.

June 15, 1930. San Benito, Texas. Same pond. I met a riband snake in the grassy edge of pond. When I stepped on it it regurgitated 9–10 transformed *H. cuneus*. This started me to working in the edges of the pond where I found several transformed ones, a very few tadpoles. I made another riband snake disgorge, thus securing more transformation stages. One of these had the light line down the back. I saw transformed *H. cuneus* in the grass and in cow-punched holes. By turning over dried cow dungs, I found several. Under one were 6 specimens, under an old shoe, others, and under a clump of matted cut weeds, still others, but no adults anywhere. I waited until dark but heard none.

Aug. 13, 1931. Brownsville, Tex. “We had our first heavy rain of the season last week, so I took advantage of the opportunity and found these little toads coming out of their hiding places and going to the water. I find them mostly in hollow holes in tree stumps close to natural water holes.”—(Letter from H. C. Blanchard).

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